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COMPOSITION OF PHILIPPINE TOBACCO-SEED OIL

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The production of tobacco is one of the largest industries in the Philippines. The value of cigars, cigarettes, and other tobacco products exported in 1935 amounted to 12,003,653 pesos (Table 1). Large stocks were also produced for domestic consumption. Taxes collected from the tobacco industry help to a very considerable extent in financing the Government.

TABLE 1.—*Tobacco exported from the Philippines in 1935.*[1]

Product.	Quantity.	Value.
		Pesos.
Cigars	223,141,286	6,798,789
Leaf tobacco, kg	33,415,030	4,014,926
Cigarettes	36,238,953	48,942
Scraps, etc., kg	1,892,173	240,241
Smoking tobacco, kg	5,994	3,314
All other kinds, kg	61,315	2,473
Total		12,108,685

[1] Philip. Statistical Rev. 2 (1936) 24.

Recently we investigated the oil obtained from Philippine tobacco seeds. The results showed that this oil has a composition similar to that of cottonseed oil, and quite likely it could be used for the same purposes for which cottonseed oil is employed.

Tobacco is now grown successfully in many districts in the Philippines, but the finest quality is produced in the Cagayan

Valley in northern Luzon, where the environmental conditions for growing tobacco are excellent. Cagayan River flows through this valley. During the rainy season the river rises, sometimes to a height of 40 feet, and all the lowlands are inundated. This overflow always leaves on the land a deposit of rich river silt, and thus annually renews the fertility of the soil and makes the use of fertilizer unnecessary. The tobacco plant is exceptionally sensitive to the effects of soil and climate. The uniform climate and the annual fertilization of Cagayan Valley give, with proper cultivation, a crop that shows only very slight variations from year to year. This region is certainly one of the richest in the world for growing tobacco.

The modern factories manufacturing cigars and cigarettes in Manila are considered show places for tourists. Manila cigars are noted for their mildness, and they find a ready sale locally and abroad.

A very interesting and instructive account of Philippine tobacco was published in the Philippine Agricultural Review, volume 20 (1927), first quarter. This issue is called the "tobacco number" and contains the following articles:

Notes on the manufacture of tobacco in the Philippines, by Domingo B. Paguirigan.

A study of the cost of production of tobacco in the Cagayan Valley, by Domingo B. Paguirigan and Ulpiano V. Madamba.

Wrapper tobacco production at the Pikit and Sarunayan Tobacco Experiment Stations and its relation to the Philippine tobacco problem, by Mariano E. Gutierrez.

The Bureau of Agriculture's work on tobacco, by Eduardo R. Alvarado.

A guide for visitors to the Bagan Tobacco Experiment Station of the Bureau of Agriculture.

A guide for visitors to the Tobacco Experiment Station of the Bureau of Agriculture at Sarunayan, Dulawan, Cotabato.

An index to bulletins, circulars, and articles on tobacco published by the Bureau of Agriculture.

A descriptive list, with cultural directions, of tobacco varieties grown and distributed by the Bureau of Agriculture, is given in circular number 186 of the Philippine Bureau of Agriculture.[1]

Some important varieties of Philippine tobacco have been analyzed by Crisostomo,[2] and comparative analyses of American and Philippine cigarettes have been made by Lava and Etorma.[3]

[1] This bureau is now known as the Bureau of Plant Industry.

[2] Philip. Agri. 23 (1934) 516.

[3] Philip. Agri. 17 (1929) 565.

Several reports [4] on the constants of foreign tobacco-seed oil have been published recently.

Roberts and Schuette [5] investigated the constituents of the oil obtained from Wisconsin-grown tobacco seeds. They found that the oil consisted principally of oleic, linolic, stearic, and palmitic glycerides.

EXPERIMENTAL PROCEDURE

The Philippine tobacco seeds used in this investigation were kindly presented to us by the Compañía General de Tabacos de Filipinas, which is one of the largest tobacco companies in the Philippines. The seeds were a mixture of the Vizcaya and Espada varieties and were obtained from plants grown in the district of Cabagan (Isabela Province) in the Cagayan Valley.

As received in the laboratory, the tobacco seeds contained some stems and dust. The seeds were first passed through a coarse sieve to remove the stems and then through a fine sieve to separate out the dust. They were ground to a fine powder which was extracted with ether. The ether extract was filtered to remove the solid material, and the filtrate distilled to eliminate the ether. The tobacco-seed oil was treated successively (warming, shaking, and filtering) with kieselguhr, suchar, and talcum powder. This treatment removed vegetable fibers and colloidal matter and produced a brilliantly clear oil that had a light yellow color with a slightly greenish tinge. The yield of oil was 39.92 per cent, calculated on a moisture-free basis. The physical and chemical constants are given in Table 2.

TABLE 2.—*Physical and chemical constants of tobacco-seed oil.*

Specific gravity at $\frac{30^\circ}{4^\circ}$ C.	0.9130
Refractive index at 30° C.	1.4714
Iodine number (Hanus)	135.8
Saponification value	190.5
Unsaponifiable matter (per cent)	1.41
Acid value	168
Saturated acids, determined (per cent)	10.43
Unsaturated acids, plus unsaponifiable matter, determined (per cent)	83.84
Saturated acids, corrected (per cent)	9.99
Unsaturated acids, corrected (per cent)	82.87
Iodine number of unsaturated acids	153.6

[4] Krugiyakov, I., Tabachnaya Prom. (1934) No. 6, 24. Belyaev, N., Masloboino-Zhirovoe Delo (1932) No. 3, 47. Varga, I., and Géza Dedinszky, Kísérletügyi Közlemények 37 (1934) 153.

[5] Journ. Am. Chem. Soc. 56 (1934) 207.

The saturated and unsaturated acids that occur as glycerides in tobacco-seed oil were separated by the lead-salt-ether method [6] in accordance with the suggestions of Baughman and Jamieson.[7] The results are recorded in Table 3.

TABLE 3.—*Separation of saturated acids from the unsaturated acids of tobacco-seed oil by the lead-salt-ether method.*

Experiment No.	Oil used.	Unsaturated acids.	Saturated acids.	Unsaturated acids (determined).	Saturated acids (determined).	Unsaturated acids [a] (corrected).	Saturated acids (corrected).
	g.	*g.*	*g.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1	10.5869	8.6219	1.9831	80.89	[b] 10.38	82.30	9.92
2	20.1192	16.3612	3.1073	83.39	[c] 10.47	82.30	10.05
Mean				83.84	10.43	82.67	9.99

[a] Unsaturated acids (unsaponifiable matter removed); iodine number (Hanus) 1356.
[b] Iodine number (Hanus), 6.8.
[c] Iodine number (Hanus), 6.2.

The unsaturated acids separated from tobacco-seed oil by the lead-salt-ether method were treated with bromine and converted into their bromoderivatives.[8] No ether-insoluble hexabromide was obtained, thus showing the absence of linolenic acid.

The composition of the mixed unsaturated acids that occur as glycerides in tobacco-seed oil was calculated from the iodine number of the unsaturated acids. The results are given in Table 4. There are also included the calculated percentages of glycerides in the original oil corresponding to these individual unsaturated acids.

TABLE 4.—*Percentage composition of the unsaturated acids of tobacco-seed oil and the glycerides corresponding to these acids.*

Acid.	Mixture of unsaturated acids.	Original oil.	Glycerides in original oil.
	Per cent.	*Per cent.*	*Per cent.*
Linolic	69.55	57.04	60.22
Oleic	30.45	25.23	26.27
Total	100.00	82.27	86.49

[6] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 556.
[7] Cotton Oil Press 6 (1922) 41. Journ. Am. Chem. Soc. 42 (1920) 2398.
[8] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats, and Waxes 1 (1921) 585.

Saturated acids.—The saturated acids were separated from tobacco-seed oil by the lead-salt-ether method and esterified with methyl alcohol. The mixed acids were dissolved in methyl alcohol and saturated with dry hydrogen chloride gas. The mixture was then heated on a water bath (reflux) for fifteen hours, after which it was treated with water and the ester layer separated. The esters were dissolved in ether and the ethereal solution was washed with sodium carbonate solution and afterwards with water. The ethereal solution was then dehydrated with anhydrous sodium sulphate, filtered, and the ether removed by distilling. The impure esters (87.7062 grams), which were yellow, were distilled under diminished pressure. A preliminary distillation was first made at about 7 millimeters pressure. The esters were redistilled at 5 millimeters pressure. Data on the distillation of the esters are given in Tables 5 and 6.

TABLE 5.—*First distillation of the methyl esters of the saturated acids. (Pressure, 7 millimeters; 87.7062 grams of esters distilled.)*

Fraction.	Temperature.	Weight.
	°C.	g.
A	179–182	31.6445
B	182–187	12.3955
C	187–192	14.2349
D	192–197	12.8866
E	197–200	6.4061
Residue		7.3199
Total		87.4875

TABLE 6.—*Second distillation of the methyl esters of the saturated acids. (Pressure, 5.0 millimeters; 87.4875 grams of esters redistilled.)*

Fraction.				
From first distillation.	Second distillation.	Temperature.	Weight.	
		°C.	g.	
A and B	1	173–177	23.4194	
C	2	177–180	18.2570	
D	3	180–187	18.0054	
E and residue	4	187–192	9.8511	
	5	192–197	8.3776	
	6	197–215	7.0228	
	Residue		1.1936	
Total			87.3870	

The analyses of fractions obtained in the second distillation of the methyl esters are given in Table 7. From these data

there were calculated the amounts of the individual acids corresponding to the methyl esters contained in the various fractions. The results are recorded in Table 8.

TABLE 7.—*Analyses of fractions obtained in the second distillation of the mixed methyl esters.*[a]

Fraction.	Iodine number.	Saponification value.	Mean molecular weight of mixed esters.	Composition of mixed esters.		Mean molecular weight of saturated esters.
				Saturated.	Unsaturated.	
				Per cent.	*Per cent.*	
1	2.2	205.0	270.2	98.60	1.50	269.8
2	3.3	205.8	272.6	97.74	2.36	272.1
3	6.7	200.9	279.2	95.42	4.58	278.6
4	10.1	194.7	288.1	93.10	6.90	287.7
5	14.1	189.8	295.6	92.13	7.87	295.6
6	14.9	181.5	304.1	91.87	8.13	304.9

[a] Calculated iodine number of unsaturated methyl esters, 146.3; calculated saponification value of unsaturated methyl esters, 192.4.

TABLE 8.—*Saturated acids corresponding to methyl esters in each fraction.*

Fraction.	Acid.							
	Myristic.		Palmitic.		Stearic.		Arachidic.	
	Per cent.	g.	*Per cent.*	g.	*Per cent.*	g.	*Per cent.*	g.
1	1.65	0.3697	91.74	21.6518				
2			85.72	16.2668	5.99	1.1136		
3			53.66	11.4815	36.96	4.8619		
4			33.42	3.2922	55.14	5.4310		
5			8.45	0.7070	70.50	6.0000		
6					60.93	5.1019	20.12	1.6791
Residue[a]								1.4744
Total		0.3697		53.4192		23.1702		3.0535

[a] Residue assumed to be methyl arachidate.

TABLE 9.—*Saturated acids.*

Acid.	Mixture of saturated acids.[a]			Glycerides in original oil.
	Weight.	Composition.	Impurities in original oil.	
	g.	*Per cent.*	*Per cent.*	*Per cent.*
Myristic	0.3697	0.69	.05	.05
Palmitic	53.4192	67.46	6.79	7.63
Stearic	23.1761	29.10	2.91	3.04
Arachidic	2.6708	3.35	0.34	0.34
Total	79.6358	100.60	9.99	10.46

[a] When separated from tobacco-seed oil, the corrected percentage of saturated acids was 9.99.

TABLE 10.—*Comparison of Philippine tobacco-seed oil with other Philippine vegetable oils.*

Constituents.	Tobacco-seed oil.	Kapok-seed oil.[a]	Peanut oil.[b]	Cotton-seed oil.[c]
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Glycerides of—				
Unsaturated acids:				
Oleic	28.87	42.8	62.9	35.2
Linolic	59.23	29.3	27.0	41.7
Saturated acids:				
Myristic	0.05	0.5		0.3
Palmitic	7.00	15.9	3.6	20.0
Stearic	1.06	2.2	1.6	2.0
Arachidic	1.34	0.5	2.4	0.6
Lignoceric			2.4	
Unsaponifiable matter	1.41	0.8	4.3	
Total	98.47	99.1	98.1	99.8

[a] Philippine kapok-seed oil (Ceiba pentandra). Cruz, A. O., and A. P. West, Philip. Journ. Sci. 48 (1932) 131.

[b] Philippine peanut oil (Valencia variety). Cruz, A. O., and A. P. West, Philip. Journ. Sci. 46 (1931) 199.

[c] American cottonseed oil. Jamieson, G. S., and W. F. Baughman, Journ. Am. Chem. Soc. 42 (1920) 1197.

In Table 9 are given the composition of the mixed saturated acids and the glycerides in the original sample of tobacco-seed oil corresponding to these acids.

The composition of Philippine tobacco-seed oil is recorded in Table 10, in which the analyses of other Philippine vegetable oils are also included for comparison. As shown by the data (Table 10) Philippine tobacco-seed oil is similar in composition to kapok, cottonseed, and peanut oils. All of these oils consist principally of glycerides of oleic, linolic, and palmitic acids. They are suitable commercially for the various purposes for which cottonseed oil is employed; that is, the high-grade oils are useful for making edible products, while the lower grades may be employed for manufacturing soap and similar commodities.

The yield of seeds from Philippine tobacco plants is comparatively small, and the oil obtained from the seeds does not contain constituents of very exceptional value. Considering these facts it would appear that the production of Philippine tobacco-seed oil as an industry is not promising.

SUMMARY

The production of tobacco is one of the leading industries in the Philippines.

The Cagayan Valley in northern Luzon is one of the best districts in the world for cultivating tobacco.

Tobacco seeds were obtained from plants grown in the Cagayan Valley. The oil extracted from these seeds had a composition similar to that of kapok, peanut, and cottonseed oils. All of these oils consist principally of glycerides of linolic, oleic, and palmitic acids, though in different proportions. Quite likely Philippine tobacco-seed oil could be used for the same purposes for which cotton-seed oil is employed.

NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XXXIII[1]

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Of Amherst, Massachusetts

TWO PLATES

The majority of the species discussed in the present report are from the Khasi Hills, Assam, where they were collected at Cherrapunji by Mr. S. Sircar. A few additional species are from southern Sumatra where they were secured by Mrs. M. E. Walsh. I am greatly indebted to Mrs. Walsh and Mr. Sircar for their appreciated interest in saving these usually neglected flies. The types of the novelties discussed herewith are preserved in my collection of the Tipulidæ.

TIPULINÆ

TIPULINI

TIPULA (SCHUMMELIA) XEDICA sp. nov. Plate 1, fig. 1.

General coloration brown, the præscutum obscure brownish yellow, with four darker brown stripes; antennæ bicolorous; pleura uniformly dark brown; legs black, the femoral bases yellow; wings with a weak brown tinge, with veins Cu and m-cu conspicuously seamed with dark brown; Rs short and straight, shorter than R_{2+3}; cell 1st M_2 diamond-shaped, pointed at both ends; cell M_1 rather short-petiolate; abdomen brownish black, the tergites only restrictedly brightened on their sublateral portions.

Female.—Length, about 14 millimeters; wing, 11.

Frontal prolongation of head brownish black; nasus distinct; palpi black. Antennæ with the scape obscure yellow; pedicel pale yellow; flagellum bicolorous, yellow, the basal enlargement of the segments dark brown; basal enlargements only weakly developed; verticils subequal in length to the segments; terminal segment reduced to a tiny conical structure. Head light brown, the posterior orbits narrowly more grayish; a capillary,

[1] Contribution from the entomological laboratory, Massachusetts State College.

median, dark brown vitta extends from the summit of the entire vertical tubercle backward to the occiput.

Pronotum dark brown. Mesonotal præscutum obscure brownish yellow, with four darker brown stripes, the intermediate pair separated by a vague paler median line; scutal lobes extensively darkened; scutellum testaceous brown, darker brown on either side of the midline, this color including most of the parascutella; mediotergite yellowish brown, darker laterally, the entire surface with coarse, erect black setæ. Pleura almost uniformly dark brown. Halteres with extreme base of stem pale, the remainder broken. Legs with the coxæ infuscated; trochanters yellow; remainder of legs black, the femoral bases yellow, narrowest on the fore and middle legs, much more extensive on the posterior pair. Wings (Plate 1, fig. 1) with a weak brownish tinge; prearcular field more yellowish, cells C and Sc pale brown; stigma dark brown, preceded and followed by restricted cream-colored areas; narrow but complete dark brown seams on m-cu and the entire length of vein Cu; anterior cord and outer veins very narrowly and insensibly seamed with brown; outer radial field weakly darkened, especially in cell R_1; wing apex, as far caudad as vein Cu, together with the axilla, very narrowly darkened; veins brown; obliterative areas of moderate size. Venation: Sc_2 ending just beyond origin of Rs, the latter short and straight, much shorter than R_{2+3}; veins R_{1+2} diverging strongly from R_2, cell R_2 very wide at margin; cell 1st M_2 strongly pointed at both ends, nearly diamond-shaped by the shortening of m; cell M_1 more than three times the length of its petiole; m-cu a short distance before the fork of M.

Abdomen brownish black, variegated by obscure yellow, the tergites restrictedly so on the sublateral portions; sternites more extensively pale. Cerci long and slender.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Strear*).

Generally similar to *Tipula* (*Schummelia*) *klossi* Edwards (Malay Peninsula), differing most evidently in the details of coloration of the body and wings, the shorter trichia of the wing veins, and in the venation, as the even more basal position of m-cu. *Tipula* (*S.*) *pendlebury*i Edwards and *T.* (*S.*) *vitalisi* Edwards are likewise related to the present fly though more distantly so.

Belongs to the *continuata* group, antennal flagellum black, only the basal segments feebly bicolorous, praescutum with three brown stripes that are confluent in front, scutum and scutellum with a median dark vitta, pleura yellow, femora obscure brownish yellow, the tips rather narrowly blackened, wings with a faint brownish tinge, stigmal region patterned with brown and variegated by more whitish areas, Rs a little longer than R, m-cu shortly before the fork of M$_{1+2}$, male hypopygium with the outer dististyle abruptly narrowed into a small blackened apical beak, surrounded beneath by an acute blackened spine, notch of ninth sternite with a depressed subcircular lobule.

Male.—Length, about 10.5 millimeters; wing, 12; antenna, about 3.5.

Frontal prolongation of head, together with the conspicuous nasus, yellow, the sides of the prolongation narrowly black, palpi black. Antennae with the scape and pedicel yellow; first flagellar segment yellow basally, darkened at outer end; succeeding two or three segments darker basally than at outer ends, the outer segments uniformly blackened; verticils a little shorter than the segments, terminal segment about one-third as long as the penultimate. Front and anterior vertex yellow, the posterior portions of vertex a little more infumed, a narrow, darker brown transverse line on posterior vertex, sometimes united medially with a small median tubercle.

Pronotum brown on median portion, yellow on sides. Mesonotal praescutum with the brown stripes that are confluent in front though narrowly separated behind, leaving a more posterior interspace of the ground color, praescutal stripes with the central portions a little paler than the borders, humeral and lateral portions of praescutum broadly yellow, scutum broadly yellow medially, the outer portions of lobes dark brown, this being a direct continuation of the lateral praescutal stripe, the median scutal area further divided by a capillary dark central vitta; scutellum yellow, with a median brown line; parascutellar fork; mediotergite pale on central portion, the sides darkened. Pleura almost uniformly yellow, scarcely or not at all variegated by darker. Halteres darkened, the extreme base of stem and area of knob a little brightened. Legs with the coxae and trochanters yellow, femora obscure brownish yellow, the tips rather narrowly blackened, the amount subequal on all legs; tibiae and

[illegible] black. Wings (Plate 1, fig. 2) with a faint brownish tinge, the prearcular field and cells C and Sc more yellowish brown; stigma dark brown, brown seams along veins Cu and m-cu, interrupted at near three-fourths the length of vein Cu by a large pale area in cell M, anterior end and outer end of cell 1st M_2 narrowly seamed with brown, veins beyond core very narrowly bordered by darker, outer ends of anal cells a little darker colored than the ground, cell 1st A with a whitish marginal spot adjoining veins 1st A and 2d A, veins dark, paler in the costal region. Venation: Rs a little longer than R_{2+3}, petiole of cell M_1 a little exceeding m, m-cu long, shortly before the fork of M_{1+2}.

Abdominal tergites obscure yellow, narrowly darkened sublaterally, sternites more uniformly yellow, hypopygium infuscated. Male hypopygium (Plate 2, fig. 23) with the caudal border of the ninth tergite, 9*t*, deeply and broadly emarginate, the dorsal surface rather strongly and convexly arched, border of emargination heavily blackened, without evident median tooth. Outer dististyle, *od*, long and slender, gradually narrowed outwardly, with very long outspreading setae. Inner dististyle, *id*, with a small blackened beak, the apical portion unusually slender, with an acute blackened point directed towards it. Ninth sternite, 9*s*, bearing at base of its median notch a small, depressed, semicircular or oval lobule, densely set with microscopic setulae.

Habitat.—Assam (Khasi Hills).

Holotype male: Cherrapunji, altitude 4,000 to 5,000 feet, August 1935, at light (*Strenzke*).

The closest described allies of the present fly are *Tipula* (*Schummelia*) *confundata* Brunetti and *T.* (*S.*) *exthoplenra* Edwards, of northern India, which differ in the structure of the male hypopygium and in the venational details, as the long more arcuated R_{2+3} and differently shaped medial cells in *confundata*, and the longer Rs, which considerably exceeds R_{2+3}, in *exthoplenra*. Edwards has given descriptions of the hypopygium characters of the two species mentioned.[1]

TIPULA (VESTIPLEX) TUTA sp. nov. Plate 1, fig. 1

Mesonotum yellow, the prescutum with four more olive-brown stripes that are very vaguely bordered by slightly darker brown, scutum and postnotum with a narrow darkened area at suture, pleura obscure yellow, tips of femora narrowly blackened, wings

[1] Ann. & Mag. Nat. Hist. [9] X (1928) 598-599.

strongly suffused with brownish yellow almost unpatterned, Rs long, subequal to vein R, petiole of cell M very short, abdominal tergites yellow, narrowly brownish yellow with dark brown sternites yellow, with a median brown line, cerci slender each with about a dozen strong teeth

Female.—Length about 17 mm; female wing, 14.2.

Frontal prolongation of head obscure yellow narrowly lined with darker on sides, nasus stout, nose black. Antennæ with the scape and pedicel obscure yellow, flagellum brown, the basal enlargements of the segments not or scarcely darkened, longest verticils a little shorter than the segments. Head obscure orange or orange-yellow with a vague, median, darker line on vertex.

Mesonotum praescutum yellow, with four more olive-brown stripes that are vaguely bordered by slightly darker brown, anterior ends of intermediate stripes barely confluent, scutum obscure yellow the lobes variegated by more olive-brown, scutellum olive-brown, narrowly darker medially, postnotum more golden-yellow pollinose with a narrow dark median vitta that is narrowed behind and does not reach the posterior margin. Pleura obscure yellow, the anepisternum and katepisternum variegated by darker. Halteres brownish yellow, the knobs dark brown. Legs with the coxæ and trochanters obscure yellow, femora brownish yellow, the tips narrowly but conspicuously blackened, the amount subequal on all legs and involving about the usual seventh or eighth of the segments, tibiæ and bases of tarsi obscure yellow, the outer narrowly darkened, remainder of tarsi darkened. Wings Plate 2 fig. 3) strongly suffused with brownish yellow, the stigma and a more or less evident cloud on anterior cord a little darker than the ground, no distinct dark pattern on wing, as is the case in all other species of the numerous subgenus, no areas across cell 1st M_2 conspicuous, veins brown. Venation: Rs relatively long, subequal to vein R_2, petiole of cell M very short, M_{3+4} subequal to basal section of M_{1+2}.

Abdominal tergites yellow narrowly bordered anteriorly with dark brown, the lateral margins narrowly buffy, a continuous, dark brown median stripe on tergites, sternites yellow with a broad, nearly continuous, dark brown median stripe. Ovipositor with cerci slender, each with about a dozen strong teeth along more than the distal half.

Habitat. Assam (Abor Hills).

Holotype, female, Chimrang, altitude 1,000 to 3,000 feet, April 20, 1912, at light (Stevens).

The nearest described ally of the present fly is *Tipula* (*Vesterplex*) *tragicornis* Brunetti, of the eastern Himalayas readily distinguished by the different wing pattern and venation. A paratype of the latter species is before me and indicates a very different fly. The pretty and distinctive wing pattern of the present insect will serve to separate the species from all others so far known.

LIMONIINÆ

LIMONIINI

LIMONIA (GERANOMYIA) MACULIPENNIS n. sp. Plate 1, fig. 4.

General color reddish, the praescutum with three narrow brown stripes; rostrum short, in the female only about one-third the length of the remainder of body, black with a pale ring just before the very short tips of the labial palpi; legs yellow; wings whitish subhyaline, heavily patterned with brown, including a series of six major costal areas, areas two to four, inclusive, whitened posteriorly and there inclosing pale centers, last dark costal area a complete subapical fenestra; Sc long, Sc$_1$ ending just before the fork of Rs; abdominal tergites dark brown, the posterior borders of the segments narrowly pale, sternites pale.

Female. Length, exclusive rostrum, about 6 millimeters; wing 6.5; rostrum, about 2.

Rostrum relatively short, in female only about one-third the remainder of body, black, narrowly pale just before the very short divergent tips of the labial palpi. Antennæ short, black throughout, flagellar segments short-oval, with verticils that are subequal in length to the segments. Anterior vertex and front obscure silvery, the color continued caudad onto the posterior vertex as a narrow line of slightly greater width, posterior portion of head blackened.

Pronotum reddish brown above, more blackened on sides and as a narrow median line. Mesonotum praescutum reddish, with three very narrow brown stripes, the median one beginning on the prescutum not attaining the suture behind, lateral stripes subequal in width to the median, reaching or passing the suture but vague and diffuse behind, scutellum, median region of scutum, and the posterior median portion of the praescutum more testaceous, postnotum reddish brown, more darkened on sides. Pleura almost uniformly reddish brown, the dorsal sclerites scarcely darker. Halteres dusky. Legs with the coxæ and trochanters yellowish testaceous, remainder of legs yellow, only the terminal tarsal segments somewhat darker. Wings (Plate 1, fig. 4) whitish subhyaline, heavily patterned with brown, including

ing a series of about six major costal areas, arranged as follows At area us, at supernumerary crossvein in cell Sc origin of Rs, tip of Sc at origin tip of vein R1, of these areas the first is small and ill-defined, spreading inward in cell Sc and thence crossing cc s R and M just beyond arculus, areas two to four widen out beh nd in cell R and here have the centers pale the lateral darkenings appearing as pincer-shaped areas in cell R, stigmal area large and extensive involving cc R, terminal area a complete subapical crossband extending from cell R2 to cell M, sending a dark spur to wing apex along vein R4, in addition to the six ma or areas, there are small outer areas in cells C and Sc only lying between the major areas one and two, two and three, and three and four, respectively, narrow, solidly darkened seams along core and outer end of cell 1st M, small brown spots at ends of veins Cu, 1st A and 2d A, the last largest a small darkened wing dot at near middle h of cell 2d A, veins dark brown Venation Sc long with Sc ending nearly opposite the fork of Rs, Sc at tip, area tip of Sc and R2 both pale and in transverse alignment, m cu close to fork of M, vein 2d A short rather strongly to wing margin, the cell present just before outer end.

Abdomen tergites dark brown, the posterior borders of the segments narrowly pale, sternites obscure yellow, genital shield chiefly pale, bases of hypovalvae blackened.

Habitat.—Assam (Khasi Hills)

Holotype, female Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935 at light (*Brewer*)

Limonia (*Geranomyia*) *moreauiana* is quite distinct from the other described regional species of the subgenus, especially in the wing pattern which is very different from that of the other Indian and Malayan species. The most similar forms are *L.* (*G.*) *crocotta* (Alexander) and *L.* (*G.*) *semistriata* (Brunetti), but the resemblance is not particularly close

LIMONIA (GERANOMYIA) SUBIMARGINATA *n. sp.* Plate 3, fig. 16

Allied to *pectoralis*, size large, wing, male, 7 millimeters), general coloration of pronotum reddish brown with three narrow darker brown stripes, pleura yellowish, the dorsal portion a little more darkened, knobs of halteres infuscated, legs yellow, wings pale yellow, with a heavy dark pattern, including six major costal areas that are pale brown, narrowly bordered by darker brown, posterior cells of wing with numerous small brown dots, Sc_2 ending opposite or shortly beyond midlength of

...male hypopygium with the median notch of the tergite shallow, ventral dististyle large, ventral spines two, arising from a common tubercle.

Male.—Length excluding rostrum about 7 millimeters, wing 7, rostrum about 3.

Rostrum relatively long, nearly one-half the length of the remainder of body, uniform throughout, from tips of labella pale brown. Antennae black throughout, flagellar segments oval, with inconspicuous verticils. Head with the narrow anterior vertex gray, the color produced caudad onto the posterior vertex almost to occiput, remainder of vertex black.

Pronotum pale yellow, narrowly darkened medially above and on sides. Mesonotal praescutum reddish brown, the humeral and lateral portions paling to light yellow, disk of praescutum with three narrow darker brown stripes, the median one wider in front, narrowed behind and reaching the suture, lateral stripes subequal in width to the interspaces, scutal lobes reddish brown, their mesal portions variegated with darker brown, scutellum chiefly pale with a narrow darker median vitta, the parascutella darker, mediotergite dark brown. Pleura yellowish, the dorsal portion a little more darkened, the color a little more expanded on the pleurotergite. Halteres pale, the knobs infuscated. Legs with the coxae and trochanters tinged with green, remainder of legs yellow, the terminal tarsal segments darkened. Wings with a pale yellow tinge, the prearcular and costal regions a very little more saturated yellow, a heavy brown pattern, chiefly costal in distribution, including six ma,or areas, arranged as follows: First at arculus, second at the supernumerary crossvein in cell St, third and fourth at origins of Rs and fork of Sc respectively, in cases united with one another among R, fifth area stigmal, sixth at outer end of R, a smaller marking at outer end of cell R, major costal areas with their central portions paler brown than the narrow dark margins, cells at outer end of cell 1st M narrowly seamed with brown, small scattered brown dots at most of the veins of the wing, including R, M, Cu, 1st A, 2d A and base of 3; in some of the cells beyond the cord, veins pale as seen in the infuscated areas. Venation: Sc entering costa opposite or shortly beyond midlength of Rs, Sc$_2$ at its tip; r-m at fork of M.

Abdominal tergites brown; sternites light yellow; hypopygium as in the larger reared. Male hypopygium (Plate 2, fig. 20) much as in *formosa*. Ninth tergite bilobed, with the median notch shallow. Ventral dististyle, d larger, the ventral prolongation

small but stout, rostral spines two, slightly unequal in size, arising from a common tubercle. Dorsal dististyle at apex produced into a long, slender darkened spine.

Habitat.—Assam (Khasi Hills).

Holotype male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*). Paratopotype male.

The most similar described species is *Limonia* (*Geranomyia*) *uniformis* Alexander,[1] which differs conspicuously in the smaller size and very different wing pattern, the dark costal areas being solidly infuscated, not pale in the centers with narrow darker borders, as is the case in the present species. Correlated with the above are minor differences in venation and in the structure of the male hypopygium.

LIMONIA (GERANOMYIA) OPTIMATA, n. sp. Plate 1, fig. 3.

General coloration reddish yellow, the praescutal disk chiefly covered by three dull black, confluent stripes, femora yellow, wings grayish yellow, with a very restricted darker brown pattern, consisting of small spots at the supernumerary crossvein in cell Sc, origin of Rs and tip of Sc, stigma darkened, Sc$_2$ ending opposite two-thirds the length of Rs.

Female.—Length, exclusive of rostrum, about 5.5 millimeters; wing 6.4, rostrum, about 1.7.

Rostrum unusually short, less than a third the length of the remainder of body, black throughout; divergent tips of horn pale, very short. Antennae with the scape dark brown, the remainder of organ black; flagellar segments oval, with short inconspicuous verticils. Anterior vertex silvery, the posterior portion of head darkened.

Pronotum pale brown above, more blackened laterally. Mesonotal praescutum reddish yellow on sides and humeral portion, the disk chiefly covered by three, dull black, confluent stripes; scutal lobes dull black, the median area somewhat paler, traversed by a narrow, more blackened median vitta; scutellum pale brown, postscutum dull black. Pleura almost uniformly yellow. Halteres with the stem yellow, the knob infuscated. Legs with the coxae, trochanters, and femora yellow; tibiae and tarsi darker brown, the terminal tarsal segments even darker. Wings (Plate 1, fig. 3) with an almost uniform grayish yellow suffusion, very restricted dark patterns as follows: a

[1] *Limonia* (*Geranomyia*) *uniformis* Alexander, Ph. Journ. Sc., 40, 1929, 94. New name for *L.* (*G.*) *pallidipennis* (Bergroth), Fauna Brit. India, Dipt. Nemat. etc., 1913, 393, preoccupied.

lows Three very small spots, at the supernumerary crossvein in cell Sc, origin of Rs and tip of Sc, respectively, stigmal area larger, oval, cord and outer end of cell 1st M, not, or at most only narrowly, stained with darker, veins yellow, darker in the infuscated portions Venation Sc of moderate length, Sc_1 ending about opposite two-thirds the length of Rs, Sc_2 at its tip, supernumerary crossvein in cell Sc at near midlength of the distance between arculus and origin of Rs, free tip of Sc_2 lying a little proximad of R_1, the latter curved gently into vein R_1 to form a composite arcuated vein; m-cu close to fork of M

Abdominal tergites dark brown, the caudal borders scarcely paler; sternites obscure yellow with broad paler posterior margins Ovipositor with the genital shield pale cereal and hypovalvae short and slender, horn-colored.

Habitat.—Assam (Khasi Hills)

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Strear*)

The most similar described species in the Oriental fauna are *Limonia* (*Geranomyia*) *abrostricta* (Edwards), of Formosa, and *L.* (*G.*) *notalipennis* (Brunetti), of the Abor district of northern Assam, both of which have the dark pattern of the wings restricted in a manner somewhat similar to that in the present fly The latter species differs evidently in the coloration of the thoracic dorsum the legs, and the wings

ANTOCHA ANTOCHA PALMERA sp. nov. Plate 1, fig. 5.

Belongs to the *vitripennis* group general coloration gray, the praescutal stripes poorly indicated, posterior portions of mediotergite and the ventral sternopleurite more blackened, antennae black throughout, the terminal segment elongate halteres pale yellow, legs black, the femoral bases restrictedly obscure yellow, wings whitish, the prearcular region more milky white, stigma oval, pale brown, veins brown, conspicuous against the ground, Rs unusually long, R_2 lying a short distance beyond level of r-m, m-cu about one-third its length before the fork of M, abdomen brownish black.

Female.—Length, about 5 millimeters; wing 5

Rostrum light brown, palpi black Antennae short, black throughout, basal flagellar segments subglobular to short-oval, intermediate segments oval, outer segments more elongate, the terminal one longest, about one-half longer than the penultimate, verticils exceeding the segments in length, except on the outer ones Head dark gray

Mesonotum gray the praescutum with the usual stripes only a trifle darker and more infuscated than the ground color, scutal lobes darkened, mediotergite more blackened on posterior half Pleura black, the surface strongly pruinose, the ventral sternopleurite more polished black dorsopleural region darkened Halteres pale yellow throughout Legs with the coxae black pruinose trochanters testaceous-yellow remainder of legs black, only the femoral bases narrowly obscure yellow, the amount subequal on all legs Wings (Plate 1, fig 6) whitish, the prearcular region clearer milky white, cells C and Sc a trifle more yellow stigma oval, pale brown, veins brown, distinct against the ground, pale in the prearcular and costal areas Vein R_3 with trichia only on about the distal fourth Venation: Rs unusually long, approximately twice R alone, R_2 relatively short and pale, traversing the outer end of stigma, subequal in length to R_{1+2}, and lying distinctly beyond the level of r-m, cell 1st M small, m-cu about one-third its length before the fork of M

Abdomen brownish black, valves of ovipositor brownish horn-color

Habitat Sumatra (20 th)

Holotype, female, Tandjong Sakti, Benkoelen, altitude 1,650 to 2,000 feet, June 1 to 10, 1933 (*Welsh*).

Antocha (Antocha) plumosa is most generally similar to *A (A.) javanensis* Alexander, of western Java, differing especially in the dark plumbeous-gray coloration, black antennae and legs, and the slightly longer Rs.

ANTOCHA (ANTOCHA) BASIFLAVA n. sp. Plate 1, fig. 7; Plate 2, fig. 17

Belongs to the *nigribasis* group, general coloration pale yellow, the thorax unmarked, vertex cartened medially, legs pale brown wings tinged with pale cream-color stigma brown, R_{2+3} short, cell 1st M_2 small, shorter than any of the veins issuing from it; m-cu far before the fork of M, male hypopygium with the inner gonapophysis appearing as very flattened, long-oval spatulate, outer apophysis a pale sinuous rod, its distal end slightly expanded, the tip acute.

Male.—Length about 2.6 to 3 millimeters, wing, 3 to 3.3

Rostrum obscure yellow; palpi brown Antennae brown throughout flagellar segment oval with short verticils. Head yellow, the vertex darkened medially

Entire thorax very pale yellow, unmarked Halteres pale yellow Legs with the coxae and trochanters yellow, remainder of legs uniformly pale brown, the terminal tarsal segments scarcely

darkened. Wings (Plate 1, fig. 7) tinged with pale cream-color, the radial field more whitened; stigma oval, brown, relatively conspicuous against the ground; veins pale brown. Venation: Sc ending at near three-fourths the length of the long Rs, R_2 subequal to R_{1+2} and a little shorter than R_{2+3}, cell 1st M small, shorter than any of the veins issuing from it; m-cu distinctly far basad, more than its own length before the fork of M.

Abdomen uniformly yellow. Male hypopygium (Plate 2, fig. 27) with the outer dististyle, *od*, a gently curved pale blade, the apex narrowly rounded. Inner basistyle, *id*, pale, a little longer than the outer, with conspicuous pale setæ on outer half. Inner gonapophysis, *ig*, a very broadly flattened, long-oval spatula; outer apophysis, *og*, a slender, sinuous, pale rod, a little widened towards outer end, the long-produced apex acute.

Habitat. Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1930, at light (*Spear*). Paratopotype, male.

Antocha (*Antocha*) *bisinuata* is readily told from the other Indian species of the *nigribasis* group by the small size, unmarked wings, venation, and structure of the gonapophyses of the male hypopygium.

All of the species of *Antocha* described from British India (Himalayan Region) by Brunetti belong to the *tripennis* group, having vein R_2 in approximate transverse alignment with r-m and with m-cu close to the fork of M. Those species include *Antocha* (*Antocha*) *indica* Brunetti, *A.* (*A.*) *trimaculata* (Brunetti), and *A.* (*A.*) *maritima* Brunetti. Four additional members of the genus recently taken in the Khasi Hills, Assam, by Mr. Shreve, belong to the *nigribasis* group, distinguished by having vein R_2 lying somewhat proximad of the level of r-m, so that vein R_{2+3} is short to very short, and with m-cu placed at a considerable distance before the fork of M. Except for the closed cell 1st M, the venation of the various members of this group is almost exactly like that of members of the subgenus *Dicranoptila* Mik.

The four species mentioned may be distinguished by means of the accompanying key:

1. Femora pale yellow, the tips narrowly and abruptly blackened; wings with a restricted dark pattern, in addition to the stigmal darkening, best evidenced by narrow seams along the cord. 2

   Femora entirely pale brown or with the tips only moderately darkened; wings unmarked except for the small stigmal area. 3

2. Prearcular field of wing and cell Sc to opposite the origin of the black cloud ..... *A. (A.) chaetocera* Alexander.
Prearcular field of wing and cell Sc entirely clear ..... *A. (A.) sparsipennis* sp. nov.

3. Thorax entirely pale yellow, mesonotum concolorous; wings nearly short as the body, about one-third of the veins beyond the origin of Rs ..... *A. (A.) humerosa* sp. nov.
Thorax yellow, the prescutum with a brown median stripe; veins beyond the larger subcostal interruption in length conspicuous, M beyond it ..... *A. (A.) scintillans* sp. nov.

ANTOCHA (ANTOCHA) SCINTILLANS sp. nov. Plate 1, fig. 4; Plate 2, fig. 23.

Belongs in the *nigribasis* group; general coloration obscure brownish yellow, the prescutum with a conspicuous dark brown, median stripe, pleura with ventral anepisternum and ventral sternopleurite weakly darkened, wings mainly white, unmarked except for the small irregular pale brown stigma; m-cu approximately its own length before the fork of M; male hypopygium with the outer dististyle at apex produced into a spike-like point, outer gonapophyses slender, nearly parallel-sided on distal portion, the tip acute.

Male.—Length, about 3.5 millimeters; wing 3.8.

Female.—Length, about 4.5 millimeters; wing 4.

Rostrum obscure yellow; palpi dark brown. Antennæ short; scape obscure yellow; flagellum brownish black; flagellar segments oval. Head reddish brown, the front, anterior vertex, and posterior orbits more buffy.

Pronotum dark brown medially, paling to yellow on the sides. Mesonotum obscure brownish yellow; the prescutum with a conspicuous, dark brown, median stripe; widest in front, suddenly narrowed behind, becoming obsolete before the suture; no trace of stem stripes; mesoscutum a little darkened, especially behind. Pleura obscure yellow, the ventral anepisternum and ventral sternopleurite slightly darkened. Halteres pale yellow throughout. Legs with the coxæ and trochanters yellow, femora obscure yellow, the tips narrowly and very inconspicuously darkened, hardly a little darker than the yellow tarsi. Wings (Plate 1, fig. 4) with the ground color milky white, the prearcular and costal portions a trifle more cream-colored, veins pale brown, even paler colored in the creamy areas; stigma small and irregular in outline, pale brown. Venation: Rs short as in the group, only about one-third of the basal section of R_{1+2}; cell 1st M_2 of moderate size, about as long as vein M_4 beyond it; m-cu approximately its own length before the fork of M.

Abdomen pale brown, the sternites and hypopygium a trifle more yellow. Male hypopygium (Plate 2, fig. 28) with the outer dististyle, *od*, rather strongly curved, at apex produced into a long spinelike point. Outer gonapophysis, *og*, slender, very gently curved, beyond the slightly dilated basal portion nearly parallel-sided for its entire length, the tip narrowed to an acute point.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Secar*). Allotopotype, female.

The closest ally is *Antocha* (*Antocha*) *bara* sp. nov., which differs especially in the uniformly pale yellow coloration, the details of venation, and the structure of the male hypopygium, notably of the outer dististyle and gonapophyses. The other related regional species may best be separated by the key given under the account of the preceding species.

ANTOCHA (ANTOCHA) SPARSIPUNCTATA, n. sp. (Plate 1, fig. 9.)

Belongs to the *nigricoxa* group, general coloration pale yellow, including the entire thorax and abdomen, tips of femora and tibiae narrowly infuscated, wings pale yellow, the prearcular, costal and subcostal areas pale, a restricted dark pattern at origin of Rs, at stigma, cord and outer end of cell 1st M$_2$, R$_{2+3}$ short, much more than its length before the fork of M, male hypopygium with the outer dististyle slender, the tip subacute.

Male.—Length, about 4 millimeters; wing, 4.5.

Rostrum yellow, palpi dark brown. Antennae brown throughout, flagellar segments oval. Head darkened above.

Entire thorax pale yellow, unmarked. Halteres pale yellow. Legs yellow; femoral tips narrowly dark brown, the amount of color subequal on all legs; tibiae yellow, tips more narrowly darkened, tarsi yellow, the outer segments infuscated. Wings (Plate 1, fig. 9) almost uniformly suffused with pale yellow, the prearcular and costal portions a very little more brightened; a restricted dark pattern, distributed as follows: Origin of Rs, cord and outer end of cell 1st M$_2$, veins pale, darkened in the infuscated portions, veins beyond cord somewhat darker in color than most of the more basal veins. Venation: Rs lying far before level of r-m, R$_{2+3}$ shortened, much more than its own length before the fork of M.

Abdomen, including hypopygium, entirely pale yellow. Male hypopygium much as in *Abacisensis*, the outer dististyle somewhat more slender, with the apex subacute.

Habitat. Assam (Khasi Hills)

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (Sircar). Paratopotype male

Antocha (Antocha) sparsepunctata holds its closest relatives in *A. (A.) kuatunensis* Alexander, which differs in the darkened wing base and cell Sc, slightly different body coloration, and the short and broad outer dististyle of the male hypopygium with the apex obtusely rounded.

[illegible]

General coloration of thorax reddish brown, the prescutum dark brown on median portion in front, lateral margin of prescutum behind the humeral region with a large velvety-black spot, thoracic pleura pruinose, with very large velvety-black areas covering most of the anepisternum and pleurotergite, halteres yellow; legs with the femora brown, the tibiae light brown with the tips narrowly darkened; wings pale gray, the prearcular area paler, stigma darker, veins brown; abdomen brown, the bases of the individual sternites paler.

Male.—Length, about 4.5 to 5 millimeters; wing, 5 to 5.8.

Female.—Length, about 5 millimeters; wing, 6 to 6.2.

Rostrum brown, palpi black. Antennae black, the basal segment more pruinose, flagellar segments oval, with a dense white pubescence and short verticils, terminal segment a trifle longer than the penultimate. Front and anterior vertex light gray pruinose, remainder of head dark gray.

Cervical sclerites dark brown, paler laterally. Pronotum yellow. Mesonotal prescutum reddish brown, broadly darker brown on median portion in front, this color paling to the ground color before midlength of the sclerite, lateral border of prescutum behind the humeral region with a large velvety-black spot, scutum and scutellum grayish brown, the latter brightened on caudal portion, mediotergite chiefly dark brown. Pleura reddish, heavily pruinose, with two large velvety-black areas, one occupying most of the anepisternum, the other most of the pleurotergite. Halteres pale yellow throughout. Legs with the coxae brownish yellow; trochanters yellow, femora brown, tibiae light brown, the tips narrowly darker brown, the amount subequal on all legs; tarsi brownish yellow to pale brown. Wings (Plate 1, fig. 10) with a pale grayish tinge, the prearcular area paler, stigma long-oval, pale brown, veins brown, the anterior branch of R_4 and R_5 paler. Venation: R_4 a little longer than R alone, gently convex, R_5 a little shorter than the slightly

more arcuate; R, petiole of cell M about one-half as long as the latter; vein more than its own length before the fork of M.

Abdomen brown, the bases of the sternites and tergites more yellowish brown; hypopygium yellow.

Habitat. Sumatra (south).

Holotype, male, Mount Tebah, Benkoelen, June 16 to 25, 1935 (*Walsh*). Allotopotype female with the type. Paratopotypes, 2 males, July 4 to 14, 1935. Paratypes, 2 females, Tandjong Sakti, Benkoelen, altitude 1,650 to 2,000 feet, June 1 to 10, 1935 (*Walsh*).

Antocha (Orimargula) praescutata is most nearly allied to *A. (O.) macalpleura* Edwards, of Mount Kinabalu, northern Borneo, which has similar velvety black spots on the thoracic pleura. The present fly is distinguished by its smaller size and the presence of a third conspicuous velvety-black area on the lateral margin of the praescutum.

BRACHYCELLUS LECTUS sp. nov. Plate 1, fig. 1

General coloration pale yellow, without conspicuous markings, antennae brownish black throughout; head gray; legs brownish yellow to pale brown; wings strongly tinged with yellow, the stigma pale, barely indicated, anterior branch of Rs sinuous, bent gently caudad opposite the stigma; cell 1st M_2 elongate subrectangular, a little longer than vein M, beyond tip; abdomen yellow, the tergal incisures and pleural membrane a little darkened.

Female. Length, including rostrum, about 0.5 millimeters; wing, 0.

Rostrum a little longer than the remainder of head; obscure yellow; palpi pale brown. Antennae brownish black throughout; flagellar segments short-oval, with inconspicuous verticils. Head gray; anterior vertex narrow, subequal to the diameter of the scape.

Cervical sclerites elongate, light brown. Pronotum and mesonotum uniform yellow to testaceous-yellow, without markings. Pleura testaceous yellow. Halteres pale, the knobs a little darkened. Legs with the coxae and trochanters testaceous-yellow; remainder of legs long and slender, femora brownish yellow, the tips scarcely darkened; tibiae pale brown; tarsi obscure yellow. Wings (Plate 1, fig. 1) with a strong yellow tinge, the prearcular and costal portions a little brighter; stigma pale, barely indicated against the ground, veins brownish yellow. Macrotrichia on veins R_2, R_{1+2}, R_5, M, and outer portions of M_{1+2}. Venation: Sc ending opposite r-m, much longer than Sc_2, which is

very short to virtually lacking; anterior branch of Rs strongly bent gently caudad opposite the stigma, the distal end more or less parallel to vein R$_{2+3}$; cell R$_2$ narrow at margin; cell 1st M$_2$ elongate, subrectangular, slightly exceeding vein M$_3$, beyond it, m-cu nearly one-half its length beyond the fork of M.

Abdomen yellow, the lateral region and incisures of the tergites restrictedly darkened, sternites more uniformly pale yellow. Ovipositor with valves elongate, horn colored.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935 (at light, *Sircar*).

The most similar regional species is the much larger *Hexatoma (Hexatoma) ferruginosa* (Brunetti), which differs in the dark body coloration and in the venation, such as the more elongate Rs and uniformly arched anterior branch of Rs, with cell R$_2$ at margin less than one-third as extensive as cell R$_3$. I am basing the above statements on a comparison of the type of *cotus* with metatypical specimens of *ferruginosa*. The latter are from lower altitudes of the Darjeeling district, eastern Himalayas, altitude 2,000 to 4,000 feet, and may not be conspecific with the actual type of *ferruginosa*, which was from the Dawna Hills, lower Burma. I believe the material is correctly named, since the venation agrees closely with that of the type as figured by Bagchi.[1]

REMARKS CHIEFLY SELECTED (p. 197, Plate I, fig. 2).

General coloration black; the prescutum with four more reddish brown stripes, rostrum black; antennae black throughout, halteres and legs black, the femoral bases and outer tarsal segments paler, wings weakly suffused with brown, the stigma and costal border darker; cell 1st M$_2$ shorter than any of the veins issuing from it, abdominal tergites black, sternites yellow, the subterminal segments obscure.

Female.—Length, excluding rostrum, about 8 millimeters; wing, 7.5.

Rostrum black, a little longer than the remainder of head. Antennae black throughout, flagellar segments oval, the outer segments more elongate, verticils subequal in length to the segments. Head black.

Cervical region and pronotum black. Mesonotal prescutum brownish black, with four more reddish brown stripes, the two

[1] Brunetti, Fauna Brit. India, Diptera Nematocera, (1912, pl. 8, fig. 8.

termediate pair only narrowly separated by a capillary dark vitta, scutal lobes dark brown, the median area obscure yellow, scutellum brownish black, mediotergite dark liver brown. Pleura with the dorsal sclerites and the pleural membrane brownish black, the ventral portion, including the outer half of the fore coxae, ventral sternopostsrite, and meron, obscure yellow. Halteres black. Legs obscure yellow, the fore coxae darkened on proximal half, trochanters obscure yellow, legs black, the femoral bases restrictedly brightened, the outer tarsal segments passing to obscure brownish yellow. Wings (Plate 1, fig. 12) with a weak brown suffusion, the stigma long-oval, darker brown, cell C brownish yellow, costa a little more darkened, veins dark brown. Costal fringe (female) dense but relatively short, virtually complete series of trichia on Rs and branches, and on outer sections of all medial veins. Venation Sc$_1$ with distal end atrophied, Sc close to its tip, Rs long and nearly straight, anterior branch of Rs gently but evenly arcuated, narrowing cell R$_1$ opposite the stigma, the tip of the vein very gently upcurved, cell R$_2$ at margin a little less than three times cell R$_1$, cell 1st M relatively small, short-rectangular, its lower face (M$_{1+2}$) shorter than any of the veins issuing from the cell, m-cu a short distance before the fork of M.

Abdominal tergites black, the sternites yellow, with the subterminal segments more obscure. Genital shield of ovipositor darkened, valves yellowish horn-colored.

Habitat. Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935 (*Strenzke*).

Allied to *Hexatoma* (*Eriocera*) *orgyia* Edwards and related forms, differing in the large size, body coloration, and wing venation.

[illegible] *longicauda* Brunetti, var. *ventralis*, new variety. Plate 1, fig. 11.

General coloration brown, the pleura more brownish yellow, wings relatively broad, faintly tinged with brown, the entire costal border narrowly more yellowish. Rs macrotrichia on anterior branch of Rs, Sc$_1$ ending a most opposite fork of Rs, free tip of Sc$_2$ long distad of it, m-cu just beyond midlength of Rs.

Male. Length, about 4.6 millimeters; wing, 4.4.

Rostrum brown, palpi black. Antennae black throughout, flagellar segments oval. Head dark brown, the front and anterior vertex a little brighter, anterior vertex relatively wide.

Prothorax dark brown. Mesonotum uniformly brown without stripes, the lateral portions of praescutum a little brightened.

Pleura brownish yellow. Halteres white, the knobs infuscated. Legs with the coxæ and trochanters yellow, remainder of legs dark brown, the tarsi a little brightened. Wings (Plate 4, fig. 13) relatively broad, faintly tinged with brown, the entire costal border narrowly more yellowish, veins pale brown, a little more yellowish in the costal field. Costal fringe relatively short; no macrotrichia on anterior branch of Rs, a series of about fifteen on distal section of vein R_{4+5}, sparse, scattered trichia on outer ends of veins M_{1+2} and M_3, remaining veins beyond cord without trichia. Venation: Sc long, Sc_1 ending almost opposite the fork of Rs; Sc_2 a short distance from its tip, free tip of Sc_1 lying distad of level of R_1; Rs long, nearly twice the basal section of R_{4+5}; R_{2+3} shorter than the basal section of R_{4+5}; r-m about equal to basal section of R_{2+3}; m-cu just beyond midlength of Rs; vein 2d A long.

Abdominal tergites dark brown, sternites more testaceous yellow; hypopygium broken.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935 (Stuart).

Orimarga (*Orimarga*) *distincta* is very distinct from the other species of the genus in eastern Asia, the chief characters being its broad wings with vein Sc of unusual length and the distal position of the free tip of Sc. In all other species of the genus the latter element is either atrophied or lies opposite to some distance before the level of Rs. The present instance is of unusual interest in that it parallels the condition found in the allied genus *Limonia*, where numerous species are known that have the free tip of Sc_2 migrated distad beyond the level of Rs.[1]

[illegible]

Orimarga is related to *Limonia* in general coloration of mesonotum gray pruinose, knobs of halteres weakly darkened, legs brownish black, wings narrow, weakly suffused with gray, the prearcular and costal regions distinctly brightened, numerous macrotrichia on veins beyond cord, Sc long, free tip of Sc faint, Rs oblique, exceeding the strongly arcuated R.

Female. Length, about 7 to 7.5 millimeters; wing 6.

[1] Alexander, C. P., The interpretation of the radial field of the wing in the Tipuloid Diptera, with special reference to the Tipulidæ. Proc. Linn. Soc. New South Wales 52 (1927): 42–92, figs. A comparison of the systems of nomenclature that have been applied to the radial field of the wing in the Diptera. 8th Internat. Congr. Ent. Trans. 1 (1928): 799–827, 5 pls.—Curran, C. H., The families and genera of North American Diptera (1934): 38–39, figs.

Rostrum obscure yellow, palpi black. Antennae black throughout; flagellar segments oval, with a short, dense white pubescence; terminal segment shorter than the penultimate. Head dark gray, more silvery on the front, anterior vertex relatively narrow, slightly blackened.

General coloration of mesonotum gray pruinose, the central portion of praescutum a little darker, median region of scutum slightly paler gray. Pleura brown, the extensive sternopleurite with paler sparsely pruinose. Halteres white, the knobs weakly darkened. Legs with the coxae reddish yellow, the fore coxae slightly darker, trochanters yellowish brown, femora brownish black, the bases narrowly and vaguely brightened, tibiae and tarsi brownish black. Wings (Plate I, fig. 14) narrow, weakly suffused with gray, the prearcular field restrictedly whitened, veins pale brown. Macrotrichia abundant on veins beyond cord, there being more than fifty-five on distal section of R_{4+5}, more crowded towards outer end of vein. Venation: Sc long, Sc, ending a short distance before fork of Rs, Sc_2 close to its tip, free tip of Sc_1 faint at a distance before Sc_2 about equal to the length of vein R_{2+3}; R_{2+3} long, exceeding the strongly arcuated Rs; R_{4+5} a little less than one-half R_{2+3}; cell M_1 longer than its petiole, m-cu placed unusually far basad, opposite the origin of Rs or nearly so.

Abdominal tergites dark brown, sternites obscure yellow to reddish yellow. Ovipositor with tergal shield pale, valves darker.

Habitat: Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1933, at light (*Sircar*). Paratopotypes, 2 females.

Orimarga (*O. imarga*) *subbasalis* is most closely allied to *O.* (*O.*) *basalis* Alexander (Kashmir), agreeing closely in the venation and trichiation of the veins, differing most evidently in the darkened knobs of the halteres, brownish black femora, and gray wings with more evidently darkened veins. In *basalis* the halteres are whitish throughout, the femora are pale with a poorly indicated darker subterminal ring, and the wings are pale yellow, with yellow veins.

PEDICIINI

Scleroprocta sinuata sp. nov. Plate 1, fig. 13; Plate 2, fig. 20.

General coloration yellow, the praescutum and scutum with a pattern of eight black spots arranged in a circle, femora entirely yellow, tibiae yellow, the tips narrowly blackened; wings whitish hyaline with a clear yellow submarginal stripe extending from

the wing base to near apex costal cell with four brown spots, the outermost at tip of vein Sc, no conspicuous dark seam on cord, cell M_2 open by atrophy of m

Male.—Length about 9 millimeters; wing 8.5

Female.—Length, about 10 to 11 millimeters; wing, 8

Rostrum and palpi yellow. Antennae yellow; only the terminal flagellar segments a very little more infuscated, flagellar segments short and crowded. Head uniformly pale yellow.

Mesonotal praescutum yellow, with three more polished yellow stripes and a transverse series of four circular black spots, the intermediate pair placed just beyond midlength of the scutum, the lateral pair a bit nearer the suture, gently curving the row, scutum with lobes deep yellow, variegated on cephalic-lateral portion and again on posterior median area of each lobe by a circular black spot. The eight marks on the praescutum and scutum thus form a short-oval figure but with no added oval darkened suture area, as in *nevermanni*, posterior sclerites of notum uniformly yellow. Pleura pale yellow throughout. Halteres yellow. Legs yellow; the femora entirely unvariegated; tips of all the narrowly but conspicuously blackened; the amount subequal on all legs, tarsi yellow, the tips of the individual tarsal segments narrowly darkened; outer tarsal segments obviously infuscated. Wings (Plate 4, fig. 1a) whitish hyaline, with the usual clear yellow costal stripe extending from the wing base to near apex, bordered both above and below by a narrow brown streak, costal portion of costal cell without black dashes but with four brown extensions, the first at tip of Sc_1, outermost at wing tip; clear cord virtually unbordered with a narrow seam on m-cu; veins Cu narrowly bordered with brown on basal portion, veins pale, darker in the cloudy areas. Venation: As in the genus, basal section of R_5 very short to vanishing, lacking; cell M_1 open by a ripple of m-cu at or close to fork of M.

Abdomen obscure yellow, the tergites very vaguely darkened at bases. Male hypopygium (Plate 2, fig. 29) with the dististyle a stout spinous interbasal element, as figured, expanded on basal portion.

Holotype.—Male (Chermapani, alt. [ca. 4,000 to 5,000 feet], August, 1933, at light (Stevens). Allotypotype, female. Paratypotypes, 2 females.

Nephrotoma lucorum is very different from the only species of the genus hitherto discovered in India, *N. ornaticornis* (Pre-

(Senior-White)[1] likewise from the Khasi Hills. By my key to the known species of *Nipponomyia*,[2] the present fly runs to couplet 6, including trispinosa (Alexander), of Japan, and acanthiata (de Meijere), of Sumatra. It is readily told by the pattern of the thorax, legs, and wings, and by the open cell M$_1$. The fly is one of the smallest species of the genus so far discovered.

GENATOMINI

ANOPHEROSTIA ANOPHEROSTIA) BIFURCATA n. sp. Plate 1, fig. 10; Plate 2, fig. 30

Genera coloration pale yellow, antennæ 16-segmented, the scape and pedicel brownish black, the flagellum obscure yellow, halteres and legs yellow, wings pale yellow, the anterior cord indistinctly darkened, the color including the veins; no trichia in cells of wing; Rs long, arcuated at origin, R$_{2+3}$ short, R$_{2+3}$ subequal to R$_1$; cell M$_1$ present, male hypopygium with the basistyle produced anteriorly into a subacute spine, outer dististyle trispinous at apex.

Male.—Length, about 4.8 to 5.2 millimeters; wing, 5.5 to 6.

Female.—Length, about 6 millimeters; wing, 6.

Rostrum dark, palpi black. Antennæ 16-segmented; scape and pedicel brownish black, flagellum obscure yellow, flagellar segments gradually becoming more slender and elongate outwardly, the longest verticils of the outer segments subequal in length to the segments themselves. Head obscure yellow, eyes (male) large, restricting the anterior vertex.

Entire thorax uniformly pale yellow. Halteres pale yellow throughout. Legs yellow, the terminal two tarsal segments darker. Wings (Plate 1, fig. 10) uniformly pale yellow, variegated only by a restricted dark cloud on the anterior cord, most evident in the dark brown veins of the area, remaining veins yellow. Wing widest just basad of end of vein 2d A, no macrotrichia in outer cells of wing. Venation: Sc$_1$ ending near opposite fork of Rs, Sc$_2$ removed a short distance from its tip, Rs long, arcuated at origin, R$_{2+3}$ relatively short, nearly twice the length of R$_{2+3}$, the latter subequal to or longer than R$_1$, veins relatively long, arcuate; cell M$_1$ small, less than one-half the petiole, placed at near midlength of lower face of cell 1st M$_2$, vein 2d A long, ending beyond the level of origin of Rs.

Abdomen including hypopygium, yellow. Male hypopygium (Plate 2, fig. 30) with the basistyle, b, produced caudad beyond

[1] Senior White, Mem. Dept. Agr. India, Ent. Ser. 6 (1923) 130-134.
[2] Alexander, C. P., Philip. Journ. Sci. 54 (1934) 551-552.

the point of insertion of the dististyles, the apex subspinous, with long coarse setæ almost to the tip. Outer dististyle, *od*, subspinous at apex. Inner dististyle, *id*, broad at base, narrowed to the obtuse tip.

Habitat. Assam (Khasi Hills).

Holotype, male Cherrapunji, altitude 4,000 to 6,000 feet, August, 1933, at light (*Sircar*). Allotopotype, female. Paratopotypes 3 males.

Adelphomyia (*Adelphomyia*) *discolor* is very distinct from the other known Asiatic species of the genus in the pale yellow wings with a single restricted darkened cloud on disk, and in the lack of macrotrichia in the cells of the wing. All other species of the genus so far made known have at least a few trichia in the outer radial or medial fields. The structure of the male hypopygium of the present fly is entirely as in the genus, and there can be no question as to the systematic position of the species.

ADELPHOMYIA (ADELPHOMYIA) FURNEBULOSA sp. nov. Plate 5, fig. 11; male 1, fig. 14.

Allied to *nebulosa*, general coloration brownish black, antennæ with basal five segments yellow, the remainder black, femora blackened outwardly, with a narrow pale yellow subterminal ring, tibiæ dark brown, the extreme base and tip pale, tarsi brownish yellow. Wings cream-yellow, with a heavy clouded brown pattern, including three virtually complete crossbands on the basal third; all veins at wing margin with large clouds, Rs some distance before fork of R, cell 1*M* longer than its petiole, anal veins strongly curved to margin, male hypopygium with basistyle terminating in a slender blackened spine.

Male. Length about 4.8 millimeters; wing, 5.

Rostrum and palpi black. Antennæ 16-segmented, scape, pedicel, and basal three flagellar segments light yellow, the remainder of flagellum black; flagellar segments becoming long cylindrical, with long conspicuous verticils that exceed the segments in length. Head brownish black, the anterior vertex paler.

Mesonotum almost uniform brownish black, the surface polished; humeral region of prænotum restrictedly obscure brownish yellow. Pleura brownish black, with a silvery longitudinal stripe across the dorsal sternopleurite and ventral pteropleurite, ending before the halteres. Halteres with base of stem and the knob yellow, the remainder of stem dusky. Legs with the coxæ and trochanters obscure yellow, femora obscure yellow

basally, passing into black at (on forelegs) or beyond (middle and hind legs) midlength, with a narrow light yellow, subterminal ring placed at about its own length before the black apex, tarsi dark brown, the base very narrowly, the first a little more broadly, whitened, the subbasal portion of the segment a little more intensely blackened, tarsi brownish yellow, the terminal two segments darker. Wings (Plate 1, fig. 17) obscure cream-yellow, with a heavy clouded brown pattern including three narrow, virtually complete crossbands or proximal and the first median, the third extending from costa opposite origin of R_5 to end of vein 2d A, on central portion of disk; these bands more diffuse and interconnected in cells M and Cu, other more isolated, dark brown spots at Sc_2, R_2, and tip of R_{4+5}, the latter two accompanied by a small pale spot behind, becoming confluent and suffusing the entire cell; other small clouds at outer end of cell 1st M and fork of M_{1+2}, a series of marginal brown clouds at ends of all longitudinal veins, smallest on R_{2+3} and M, becoming progressively larger behind, most extensive on the anal veins, proximal third of cell R_1 clouded, veins pale, darkened in the suffused areas. Rather restricted macrotrichia on outer cells of wing, including cell R_2 beyond vein R_2, and in the outer ends of cells R_3 to 2d M$_2$, inclusive. Wings (male) widest opposite the end of cell 1st A. Venation: Sc_1 removed to some distance from the tip of R_1; R_{2+3} short, fork opposite, some distance from fork of R_{4+5}; tips of veins R_3 and R_4 bent rather strongly cephalad at the medial, costal, and anal veins, strongly caudad, especially the last; basal section of M_{1+2} reduced to a point, narrowing the base of cell 1st M, r-m correspondingly lengthened, cell M_1 deeper than its petiole, m-cu about one-half its length beyond the fork of M.

Abdomen black, hypopygium a trifle paler, more brownish black. Male hypopygium (Plate 2, fig. 31) with the basistyle broadly terminating abruptly in a slender blackened spine. Outer dististyle, *ed*, slender, with two outer, terminal, curved spines and an inner, subapical spine.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1925, at light (Evans). Paratopotypes, males.

The only species of the present fly as *Adelphomyia* (*Adelphomyia*) *nebulosa* (de Meijere), of western Java, which has the venation of the radial and medial field almost the same as in the insect under consideration. This latter species differs most noticeably in the details of coloration of the legs and wings.

From de Meijere's figure of the type of *velutinus* it appears that in this species the macrotrichia of the cells of the wing are more numerous and that the anal veins are not strongly curved into the wing margin. It is certain that the generic name *Oxydiscia*, proposed by de Meijere for this fly, must fall as a strict synonym of *Adelphomyia*, the male hypopygium being so very distinctive.

TIPULA (DELANGOPHRAGMA) MULTIGEMINATA sp. nov. [illegible]

General coloration of mesonotum reddish brown, the posterior sclerites and the pleura more blackened, antennæ black, the pedicel and first flagellar segment yellow, eyes yellow, the femora with a very indistinct darker subterminal ring, wings broad in male, narrower in female, pale yellow, heavily patterned with dark brown, the areas restricted to the vicinity of the veins, markings along costa and at the supernumerary crossvein in cell R_1 more extensive and subtended on either side by smaller dark spots, a series of subterminal brown spots in cells R_1 to 1st A, abdomen black, the hypopygium more brightened.

Male.—Length, about 5.5 millimeters; wing, 6.

Female.—Length, about 6.5 to 6.8 millimeters; wing, 6 to 6.2.

Rostrum and palpi black. Antennæ short in both sexes, scape [illegible] of flagellum black, basal segments with [illegible] Head black.

Pronotum dark brown. Mesonotal prescutum reddish brown, darkened in front and on sides; scutum reddish brown; scutellum and postnotum dark brown, sparsely pruinose. Pleura black. Halteres weakly suffused with dusky, the base of stem restrictedly paler. Legs with the coxæ brownish black, trochanters obscure yellow, the tips narrowly darkened, femora yellow, with a narrow and very indistinct darker ring just before the tip, remainder of legs yellow, setæ of legs very long and conspicuous. Wings (Plate 1, fig. 13) much broader in male than in female; in the former widest opposite the termination of vein 2d A, ground color pale yellow, the basal cells slightly washed with dusky, a heavy dark brown pattern that is chiefly confined to the vicinity of the veins, the interspaces being immaculate, the chief markings are as follows: Postarcular, origin of R_2 along costa and centering about the supernumerary crossvein in cell R_2, these markings narrowly bordered by yellow and subtended

[illegible] Ent. 51 (1923), p. 17, fig. 16.

on either side by smaller spots, outer end of cell 1st M_2 and fork of M_3 + Cu_1 restrictedly darkened, a series of small subterminal spots in cells R_1 to 1st A, respectively, placed just cephalad of the vein and slightly back from the margin, the vein beyond this point more heavily darkened to the wing border, extreme axilla weakly darkened, veins pale, darker in the clouded areas. Venation: Supernumerary crossvein in cell R_2 oblique, placed at near two-thirds the length of cell; cell M_1 shallow, subequal to its petiole, cell 1st M_2 subrectangular, a little widened outwardly, m-cu about one-half its length beyond fork of M_3 + Cu_1, vein 2d A bent rather strongly to border, simple in both sexes.

Abdomen black, the hypopygium more brightened. Male hypopygium (Plate 2, fig 32) with the outer dististyle, of nearly straight, unequally bidentate at tip, the terminal spine much stouter and more strongly curved than the outer subapical one.

Habitat.—Assam: Khasi Hills.

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1933, at light (Sircar). Allotopotype, female. Paratopotypes, several females.

The nearest relative of the present fly would appear to be *Limnophila* (*Dicranophragma*) *venustipennis* Alexander (*pulchripennis* Brunetti, preoccupied), of the eastern Himalayas. The present species is distinguished by the simple 2d anal vein of both sexes and the nature of the wing pattern, especially the geminate smaller spots subtending the larger dark areas along the cord and in the outer radial field. It seems virtually certain that Brunetti had two species confused in his original description. The true *venustipennis* is discussed in some detail below.

LIMNOPHILA (DICRANOPHRAGMA) VENUSTIPENNIS Alexander

Dicranophragma pulchripennis Brunetti, Fauna Brit. India, Dip. Nematocera (1912) 624 (preoccupied in *Limnophila*).

Limnophila (*Dicranophragma*) *venustipennis* Alexander, Insec. Insecit. Menst. 9 (1921) 110.

Several females that I am referring to this species are from Cherrapunji, Khasi Hills, Assam, altitude 4,000 to 5,000 feet, taken at light, August, 1933, by Mr. S. Sircar. The wings of the female are much narrower than in the males, while the 2d anal vein is simple. In the males of the type series of *pulchripennis* vein 2d A is forked near its outer end, as described by Edwards[1] and shown by a paratypical specimen in my collection. The proximal spur of this fork is surrounded by the most basal

[1] Rec. Indian Mus. 26 (1924) 303.

of the enlarged dorsomedian group of the wing. Dorsum [illegible] brown, the surface thickly covered by more reddish brown stripes.

[illegible]

TRENTEPOHLIA (MONOTOMA) SUBTENUIS sp. nov. Plate 1 fig. 18.

Allied to *tenera*. Genera coloration of mesonotum almost uniformly dark brown, the scutellum clear yellow, femoral tips and tibial bases narrowly but conspicuously whitened, tibial tips [illegible] wing with the ground color pale gray, cell R$_5$ and R$_{2+3}$ whitened, base of cell R$_5$ lying a little more distad than that of vein M$_3$.

Female. Length, about 8 millimeters; wing, 6.3.

Rostrum obscure yellow; palpi black. Antennae black throughout, flagellar segments oval, the outer two segments shorter [illegible] than the normal pubescence. Head dark gray, anterior vertex reduced to a linear strip.

Pronotum above dark brown. Mesonotal praescutum and scutum almost uniformly dark brown, the median area of the latter [illegible] slightly darker, postnotum yellowish brown. Pleura with the dorsal [illegible] yellow. Halteres dusky. Legs with the coxae brownish yellow, the fore coxae a trifle darker, trochanters yellow; femora dark brown, the tips rather narrowly but conspicuously white, the amount subequal on all legs and involving [illegible] tibiae dark brown, [illegible] ground color, tibial tips broadly, conspicuously, and abruptly snowy white, including approximately one-fourth the total length of the segment, [illegible] the snowy-white vestiture more erect and conspicuous, posterior femora with about ten small spines in a linear row near base. Wings (Plate 1 fig. 18) relatively narrow, uniformly pale gray, cell Sc a trifle darker; veins pale brown. A scattered series of about eight trichia on vein R$_1$. Venation: Sc ending just before [illegible] of R; R$_1$ a little longer than the basal section of R$_5$ and about in alignment with it, R$_{2+3}$ long, gently arcuate; R$_2$ and R$_3$, subequal, R$_2$ oblique and

1st M_3 gradually widened outwardly, fork end of cell R_5 lying a trifle more distad than that of cell M_1, stem close to fork of M_3, apical fusion of veins Cu_1 and 1st A relatively extensive, longer than the basal section of M_{1+2}.

Abdominal tergites dark brown, the basal segments a little paler, sternites obscure yellow to brownish yellow.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*).

By the keys to the Oriental species of *Trentepohlia* the present fly runs to *Trentepohlia* (*Mongoma*) *fenera* (Osten Sacken), from which it differs in the coloration of the legs and the venation, especially the length of veins R_{2+3}, basal section of M_3, and apical fusion of Cu_1 and 1st A. Brunetti placed his species *pallidventris* "as a synonym of *fenera*, but this is evidently an error. The species has the femora and tibiae whitened on, at the tips.

TRENTEPOHLIA (MONGOMA) WALKERIANA sp. nov. Plate 1, fig. 16.

Thorax entirely orange, immaculate; antennae dark throughout, head gray, the posterior portion of vertex and the occiput fading to brown, halteres pale, the knobs light yellow, legs brownish black, the base of tibiae and the tarsi pale to yellow, wings with subhyaline, the prearcular and costal fields clear light yellow, a restricted dark pattern, including the wing tip, also small black stigmal and restricted, variegations by yellow.

Female.—Length, about 10 to 11 millimeters; wing, 9 to 10.

Rostrum dark brown to black, palpi black. Antennae with scape and pedicel dark brown to black; flagellum black, flagellar segments cylindrical, relatively elongate. Front and anterior vertex light gray, the posterior vertex dark gray in front, passing to brown behind and on the occiput, anterior vertex reduced to a narrow strip, its posterior portion strongly carinate, the ridge continued caudad onto the posterior vertex.

Cervical sclerites light brown. Pronotum and mesonotum anteriorly bright orange, the posterior third more yellow. Halteres obscure brownish yellow, the base of stem narrowly yellow, the apex of knob clear light yellow. Legs with the coxae and trochanters yellow, femora dark brown to brownish black, the extreme bases orange, heavily ringed; tibiae pale brown to brownish yellow, becoming brighter at outer ends, the forepair more so

[1] Fauna Brit. India Dip. Nematocera, 1913: 481; Rec. Indian Mus. 9: 19 fig. 212.

tensively brightened basal light brownish yellow, femora with about four to twelve small erect spines, fewest on posterior femora. Wings (Plate 1, fig. 20) whitish subhyaline, the prearcular region and costa C and Sc clear light yellow, stigmal area small and restricted, triangular in outline, brownish yellow, wing tip narrowly infuscated, including cells R_1 to 2d M_2, veins R_2, cord, and Cu narrowly seamed with brown, veins brown, a little darker in the clouded areas, clear yellow in the flavous portions. Venation: R_2 a short distance before fork of R_{2+3}, its cephalic or proximal end faint to ill-defined in the stigmal area, basal section of M_1 slightly angulated, more close to or shortly before fork of M, apical fusion of Cu and 1st A punctiform.

Abdomen chiefly black, with faint bluish reflections, the dorsopleural region pale, lateral margins of tergites and base laterally spots on sternites restrictedly yellow, in cases the sternal pale spots are more extensive, forming nearly complete crossbands on the basal rings of the segments. Ovipositor and genital segment deep yellow.

Habitat.—Sumatra (south).

Holotype, female, Bukit Jtam, Benkoelen, altitude 1,000 to 2,000 feet, June 11 to 14, 1935 (*Walsh*). Paratopotype, sex?

I take great pleasure in naming this beautiful crane fly in honor of the collector, Mrs. M. E. Walsh. The nearest described species is *Tanyptera (Mongoma) nericosta* Alexander (western Java), which differs conspicuously in the coloration of the body, and the details of pattern of the legs and wings.

TRIMICOMYIA (MONGOMA) CYRTOPTERA, n. sp. Plate 6, fig. 21.

General coloration of thorax black, the lateral and humeral portions of praescutum yellow; halteres brownish black, femora and tibiae brownish black, the tips of the latter and the tarsi paling to yellow, wings whitish subhyaline, the prearcular and costal regions not conspicuously brightened, a weak darkened pattern, including the wing tip, stigma, and seams along vein Cu and origin of R_5, abdomen black, the basal rings of the intermediate sternites narrowly obscure yellow.

Female.—Length, excluding head, about 8 millimeters; wing 7.4.

Head broken.

Cervical sclerites blackened. Pronotum brownish black above, obscure yellow basally on sides. Mesonotal praescutum obscure yellow on humeral and lateral portions, the entire disk covered by three confluent brownish black stripes that cross the suture

and include the scutal lobes, scutellum and postnotum brownish black. Pleura brownish black, the dorsopleural membrane and meral region a little paler. Halteres brownish black, the base of stem narrowly yellow. Legs with the fore and middle coxae black, the posterior coxae and all trochanters obscure yellow; femora brownish black, the extreme bases restrictedly brightened, tibiae black, the distal ends paling to obscure yellow or brownish yellow, armature of legs including a series of four long erect setae on distal fourth of posterior tibiae. Wings (Plate 1, fig. 21) whitish subhyaline, including the prearcular region and basal half of costal field, outer portions of cells C and Sc a little more yellowish, stigma conspicuous, dark brown, wing tip weakly and rather narrowly infuscated; narrow but conspicuous brown seams along vein Cu and at origin of Rs, the remainder of cord very insensibly darkened, veins brown, paler in the costal and prearcular fields. Venation: R_2 about one-third its length before the fork of R_{2+3}, m-cu close to fork of M, inner end of cell M_2 a little more basad than that of cell R_1, apical fusion of veins Cu, and 1st A punctiform.

Abdomen black, the pleural membrane paler, basal rings of intermediate sternites narrowly obscure yellow. Ovipositor and genital segment yellow.

Habitat. Sumatra (south).

Holotype, female, Tamijang Santi Benkoelen, altitude 1,600 to 2,000 feet, June 11 to 20, 1935 (*Welch*).

Trentepohlia (*Mongoma*) *ephippata* is allied to species such as *T* (*M*.) *exsecta* Alexander, *T* (*M*.) *basicellis* Edwards, *T* (*M*.) *hamatica* Alexander, and *T* (*M*.) *walshamae* sp. nov. differing conspicuously in the coloration of the body. The blackened discal sandle of the mesonotal prescutum is distinctive.

TRENTEPOHLIA (TRENTEPOHLIA) STERNENS sp. nov. Plate 1, fig. 21.

Size very large, legs long and powerful, general coloration ferruginous yellow, the thorax unmarked, head gray, the vertex strongly contrasting, legs yellow, the femora, tips, tibiae, bases, and distal tips conspicuously blackened, wings pale yellow, the costal and outer radial fields more saturated yellow, restricted dark seams on veins R_2, basal section of M_{1+2}, m-cu, and fork of R_1 + M_{1+2}, abdomen yellow, the subterminal segments slightly infuscated.

Male.—Length, about 8 millimeters; wing, 7. Posterior leg, femur 12, tibia, 12.5, tarsus, 8.

Rostrum obscure yellow; palpi brownish black. Antennae brownish black, the scape a little brightened; flagellar segments

cylindrical, with dense dark pubescence. Head gray, anterior vertex narrow, the carina conspicuous.

Cervical sclerites obscure yellow. Thorax entirely ferruginous-yellow, the surface somewhat polished. Halteres yellow throughout. Legs with the coxæ and trochanters yellow, femora yellow, the tips rather broadly and very conspicuously blackened, tibiæ obscure yellow, the bases narrowly darkened, the tips broadly blackened; tarsal brownish black; legs unusually long and powerful, as shown by the measurements given above, femora with scattered erect setæ over the entire length. Wings (Plate 1, fig. 22) pale yellow, the costal and outer radial field more saturated yellow, a restricted dark pattern, including a narrow brown seam on vein R_2 and somewhat darker seams on posterior cord and fork of $R + M_{1+2}$, veins yellow, darkened in the clouded areas. Venation: m-cu short, only before fork of M_1, distal section of Cu_1 strongly arcuated, its apical fusion with 1st A slight.

Abdomen yellow, the subterminal segments slightly infuscated.

Habitat.—Sumatra (south).

Holotype, male, Tandjong Sakai, Renkoelen, altitude 1,650 to 2,000 feet, June 21 to 30, 1935 (*Wenk*).

Trentepohlia (*Trentepohlia*) *strepens* is the largest species of the subgenus so far made known, as is well shown by the leg measurements given above. It is allied to *T.* (*T.*) *holoxantha* Alexander and *T.* (*T.*) *segregans* Alexander, especially to the latter, differing especially in the major size and in the distinctive pattern of the wings.

HOLOPHILUS KRAMERI sp. nov. Plate 1, fig. 21; Plate 2, fig. 31.

Belongs to the *grandis* group and subgroup; general coloration brown, antennæ (male) short; wings brownish yellow, the macrotrichia dark brown; abdomen dark brown, the hypopygium more yellowish; male hypopygium with all three lobes of basistyle obtuse at tips, with setæ throughout their lengths, three dististyles, all simple rods that are very markedly sinuous, the tips acute or subacute, intermediate and inner styles with spinose on distal third.

Male.—Length, about 3.8 millimeters; wing, 4.4.

Rostrum dark brown, palpi black. Antennæ (male, short if bent backward ending far before the wing root, scape and pedicel light yellow, flagellum dark brown, flagellar segments short cylindrical, with long conspicuous verticils. Head dark brownish gray;

Pronotum brownish black. Mesonotal prescutum dark brown, with a faint reddish coat, somewhat darker colored laterally and on extreme cephalic portion, scutum and scutellum brown, mediotergite darker colored. Pleura dark brown, with a vague paler longitudinal stripe across the dorsal sternopleurite and ventral pteropleurite, beginning behind the posterior coxæ. Halteres pale yellow throughout. Legs with the coxæ and trochanters brownish yellow, remainder of legs brownish yellow, with dark-colored setæ that obscure the ground; outer tarsal segments more uniformly dark brown. Wings (Plate 1 fig. 23) with a strong brownish yellow tinge, the veins darker brown, macrotrichia dark brown; costal fringe long and dense. Venation: R_2 about opposite r-m, m-cu about one-half the petiole of cell M_1, vein 2d A ending opposite caudal end of m-cu.

Abdomen dark brown, the large hypopygium more yellowish. Male hypopygium (Plate 2, fig. 33) with all three lobes of basistyle, b, simple and nonspinous, with setæ to their tips. Three dististyles, the outer, *od*, a strongly sinuous, slender rod, its distal third straight, intermediate style, *md*, a simple rod, its distal third very strongly bent and thence narrowed into a spine; basal portion of style bearing a linear row of slender teeth; inner style, *id*, a strongly curved simple rod, its distal third with a series of five or six strong spinules. Phallosomic plate oval in outline.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1930, at light (Sircar).

The *Molophilus* fauna of the Himalayan region is still very poorly known. From the few species hitherto described the present fly is readily told by the unusually large and complicated male hypopygium, in conjunction with the short antennæ of the male sex. The most generally similar species seems to be *Molophilus gentilis* (Brunetti), which has the male hypopygium of entirely different conformation.[1]

TRICHOMITRA CERATOCHELIUM MESOMELINICA n. var. Plate 1 fig. 24; Plate 2 fig. 34.

General coloration of mesonotal prescutum dark brown, the lateral margins gray, rostrum much shorter than the wing, anterior vertex wide; legs brownish black, wings pale gray, veins light brown, no macrotrichia on Rs or its anterior branch, abdomen brownish black, male hypopygium with the dististyle pro-

[1] Edwards, F. W. Rec. Ind. Mus. 26: 1924) 360.

duced into a long, straight, apical point, on outer margin at near one-third the length bearing a pale fleshy spine.

Male.—Length, excluding rostrum, about 6 millimeters; wing, 5.3; rostrum, 3.5.

Rostrum much shorter than the wing black throughout. Antennæ black, the first segment a little pruinose but not at all brightened. Head brown, the front, anterior vertex, and broad posterior orbits light gray, anterior vertex unusually broad, approximately one-third the width of the head at this point, or equal to the visible diameter of either eye.

Pronotum dark brown. Mesonotal præscutum with the dorsum largely occupied by three, confluent, dark brown stripes that reserve the dull gray ground color in the humeral and lateral portions, scutal lobes dark brown, the median area more grayish, scutellum and postnotum gray. Pleura blackened, the dorsopleural membrane and dorsal sclerites much darker than the sternopleurite and coxal areas, the dark color continued caudad beneath the wing root and including the lateral and caudal portions of the mediotergite. Halteres obscure yellow. Legs with the coxæ gray, trochanters yellowish brown, remainder of legs brownish black. Wings (Plate 1, fig. 24) with a uniform pale gray tinge, veins light brown. No macrotrichia on Rs or on anterior branch, posterior branch with a series of about twenty on distal section of vein R_1; seven or eight trichia on outer section of vein M_{1+2}. Venation: Sc_1 ending just beyond origin of Rs, the latter a little more than one-half as long as the sinuous anterior branch, r-m close to fork of M.

Abdomen brownish black; hypopygium very similar to that of *Hexatoma hypopygiana* (Plate 2, fig. 34) with the basistyle, b, provided with a blunt lobe on mesal face near base that is lobe tipped with numerous long coarse setæ. Apical outer dististyle, d, produced into a long straight apical point, on outer margin at near the basal third with a slender, gently curved fleshy spine. Arms of aedeagus, a, reduced very short.

Habitat.—Assam (Khasi Hills).

Holotype, male, Cherrapunji, altitude 4,000 to 5,000 feet, August, 1935, at light (*Sircar*).

Tasiocera (*Cordilecteidea*) *mesorhyncha* is readily told from *T.* (*C.*) *brevifrons* (Brunetti), likewise from Assam, by the wide anterior vertex, short rostrum, uniformly darkened antennæ, and darkened abdominal sternites. I have provided below a redescription of the holotype specimen of *brevifrons*.

TAXOMERIA (TAXAVORACEA) BREVIPENNIS (Brunetti).

Ceratolaus brevipennis BRUNETTI, Rec. Indian Mus. 13 (1918) 399.

The holotype, a female, was taken above Tura, Garo Hills, Assam, altitude 3,500 to 3,900 feet, August, 1917, by Dr Stanley Kemp. I am indebted to Dr H Singh Pruthi for the opportunity to reexamine this specimen and have provided additional notes concerning certain critical points.

Female.—Length, excluding rostrum, about 7 millimeters, wing, 6.8, rostrum about 8.

Rostrum elongate, exceeding the remainder of body, black throughout. Antennæ black, the small scape obscure yellow. Anterior vertex very narrow, only a little wider than the antennal pedicel, the sides concave, head beneath a little wider than on the vertex. Head brownish gray, the anterior vertex and orbits clear light gray.

Mesonotum dark brown, the humeral region and narrow lateral margins of the prescutum brighter, median region of the scutum paler than the loons. Pleura dark dorsally, the dorsal portion of the sternopleurite more brownish yellow. Halteres relatively short, dusky. Legs dark brown, the femoral bases restrictedly paler. Wings with a faint brown tinge, veins dark brown. Macrotrichia of veins relatively abundant, there being a series of about five on Rs, apparently lacking on the distal section of M_4, a single puncture of R_{2+3} shortly beyond origin, a series of at least thirty trichia on distal section of R_5; about eight on basal section of R_5. Venation: Sc, ending about opposite two-fifths the length of Rs, Sc_2 before the origin of Rs; Rs and the two sections of R_5 in sinuous alignment, R_{1+2} relatively long, ending beyond the level of r-m, cell 1st M_2 closed, relatively large, m-cu just beyond the fork of M, approximation of veins Cu and 1st A relatively slight.

Abdominal tergites dark brown, the sternites yellowish brown; genital segment obscure brownish yellow. Ovipositor with the tergal valves very long and slender, the basal three-fourths or more straight, the apex gently upcurved, external valves more compressed, horn-colored.

The sides of the anterior vertex are strongly concave, not convex, as indicated by Brunetti. Two of the figures given by Brunetti (loc. cit., pl. 8, figs. 12, 13) as representing *Toxolabus nigroscapus* Brunetti pertain to a species of *Ceratolaus*, presumably *C. latifrons* (Brunetti).

ILLUSTRATIONS

a, Abdomen; b, basistyle; d, dististyle; g, gonapophysis; i, interbase; id, inner dististyle; ig, inner gonapophysis; mf, middle flagellum; od, outer dististyle; og, outer gonapophysis; s, stemite; t, tergite; vd, ventral dististyle.

PLATE 1

FIG. 1. *Tipula* (*Schummelia*) *modica* sp. nov., venation.
2. *Tipula* (*Schummelia*) *pergrata* sp. nov., venation.
3. *Tipula* (*Vestiplex*) *tufa* sp. nov., venation.
4. *Limonia* (*Geranomyia*) *arcuata* sp. nov., venation.
5. *Limonia* (*Geranomyia*) *offirmata* sp. nov., venation.
6. *Antocha* (*Antocha*) *plumbea* sp. nov., venation.
7. *Antocha* (*Antocha*) *bestiana* sp. nov., venation.
8. *Antocha* (*Antocha*) *scalata* sp. nov., venation.
9. *Antocha* (*Antocha*) *sparsipunctata* sp. nov., venation.
10. *Antocha* (*Orimarga*) *punctulata* sp. nov., venation.
11. *Helius* (*Helius*) *lectus* sp. nov., venation.
12. *Helius* (*Helius*) *secretus* sp. nov., venation.
13. *Orimarga* (*Orimarga*) *distracta* sp. nov., venation.
14. *Orimarga* (*Orimarga*) *subnasalis* sp. nov., venation.
15. *Nipponomyia khasiana* sp. nov., venation.
16. *Adelphomyia* (*Adelphomyia*) *furcata* sp. nov., venation.
17. *Adelphomyia* (*Adelphomyia*) *subcubitalis* sp. nov., venation.
18. *Limnophila* (*Dicranophragma*) *multigeminata* sp. nov., venation.
19. *Trentepohlia* (*Mongoma*) *skintchera* sp. nov., venation.
20. *Trentepohlia* (*Mongoma*) *ion* Alexander, venation.
21. *Trentepohlia* (*Mongoma*) *ephippiata* sp. nov., venation.
22. *Trentepohlia* (*Trentepohlia*) *strepens* sp. nov., venation.
23. *Molophilus khasicus* sp. nov., venation.
24. *Toxorhina* (*Ceratocheilus*, *metarhyncha* sp. nov., venation.

PLATE 2

FIG. 25. *Tipula* (*Schummelia*) *pergrata* sp. nov., male hypopygium.
26. *Limonia* (*Geranomyia*) *fumirarginata* sp. nov., male hypopygium.
27. *Antocha* (*Antocha*) *bantiana* sp. nov., male hypopygium.
28. *Antocha* (*Antocha*) *scalata* sp. nov., male hypopygium.
29. *Nipponomyia khasiana* sp. nov., male hypopygium.
30. *Adelphomyia* (*Adelphomyia*) *furcata* sp. nov., male hypopygium.
31. *Adelphomyia* (*Adelphomyia*) *subcubitalis* sp. nov., male hypopygium.
32. *Limnophila* (*Dicranophragma*) *multigeminata* sp. nov., male hypopygium.
33. *Molophilus khasicus* sp. nov., male hypopygium.
34. *Toxorhina* (*Ceratocheilus*) *metarhyncha* sp. nov., male hypopygium.

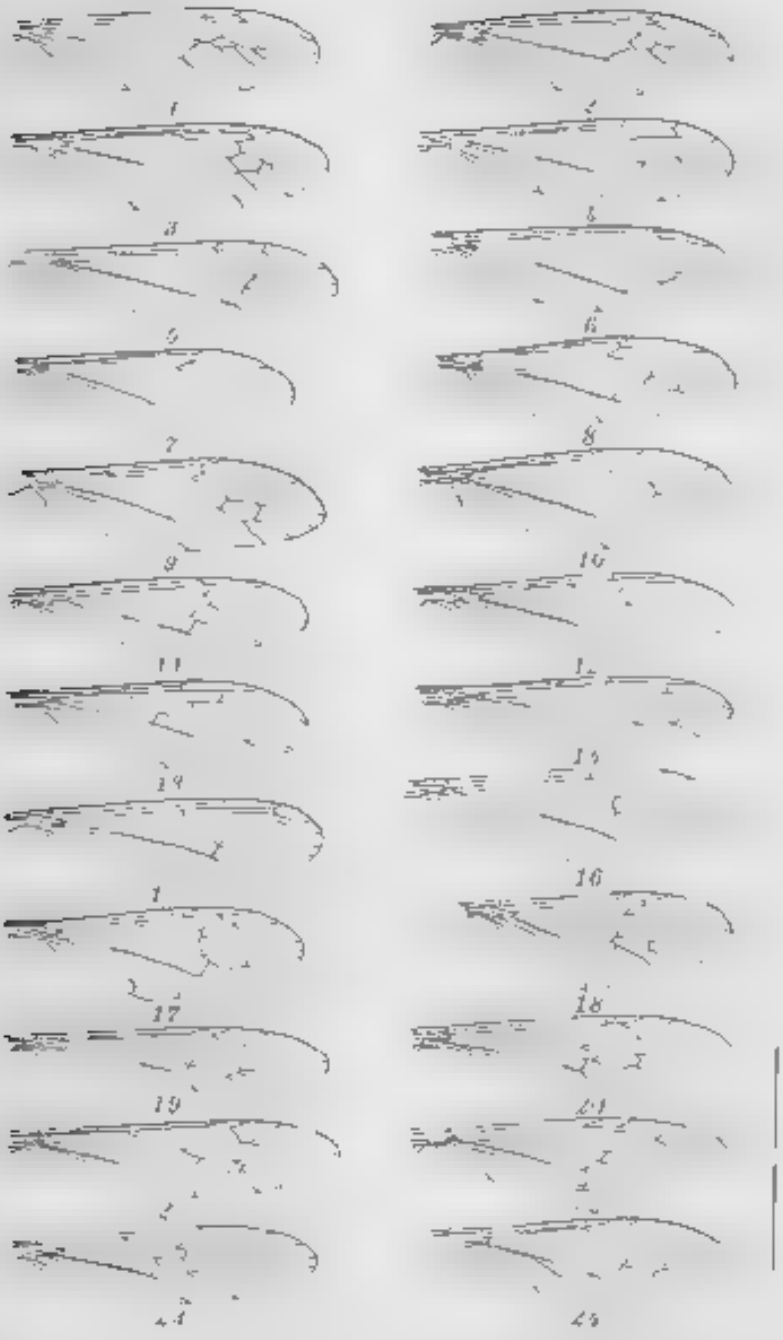

PLATE 1.

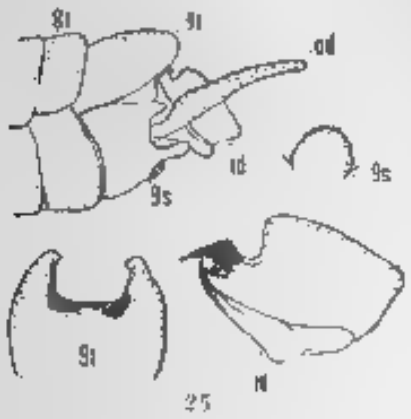

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PLATE 2

NOTES ON PHILIPPINE MOSQUITOES. VI

THE PUPAL CHARACTERS OF ANOPHELINES OF THE SUBGENUS MYZOMYIA

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TWENTY-FIVE PLATES

The material upon which this paper is based was collected mainly in Luzon. *Anopheles parangensis* and one *A. indefinitus* found breeding with *parangensis* are from Davao, Mindanao, and two *A. subpictus* var. *flavirostris* are from Itbayat Islands, Batanes.[1]

Among Philippine *Anopheles* some closely related varieties and species are easily separated in the egg stage (as the local varieties of *sinensis*) others are very difficult if not impossible to differentiate by the characters of the eggs, but are readily separated by the characters of the larvæ (such as *Anopheles hyrcanus* var. *germanus* and *A. hyrcanus* var. *vagus*), while still others, which are very much alike in the larval stage, possess marked differences in the pupæ (as *A. hyrcanus* var. *pseudosinensis* and *A. hyrcanus* var. *vagus*, or *A. leucosphyrus* and *A. leucosphyrus* var. *balabacensis*). It would seem, therefore, that the conclusions of Hackett (1934, 1935) and other European workers with regard to the reliability of egg characters (because they are genotypic in nature) in the differential diagnosis of the varieties of *maculipennis*, and the claim they make that morphological differences in the larvæ and adults are unstable (therefore, unreliable because they can be so modified by en-

To the many persons and entities mentioned in the previous parts of these Notes, I have to add Major W. C. Dunham, formerly Health Adviser to the Governor General, now High Commissioner, who gave to the malaria section of the Bureau of Health specimens of *A. maculatus* var. *flavirostris*, which the Major himself collected in the Batanes; and Mr. Andres Nuno, civilian field director of the malaria control work at Iwahig and David Penal Colonies, who kindly gave me specimens of *parangensis* and other rare species from Palawan and Mindanao Island.

ironment as to obscure the genetic differences, cannot be completely applied to the classification of Philippine species of *Anopheles*. It seems that a consideration of the characters in all stages, whenever possible, should be the basis of classification.

Unlike the species of the subgenus *Anopheles* which can be readily separated in the pupal stage many of the forms of the subgenus *Myzomyia* do not possess marked specific characters. The groups, however, are quite easily separable, as shown in the following key.

Key to groups of the subgenus Myzomyia based on pupal characters.

1 Paddle hair short, straight, *A* VII blunt, at most 0.4678 mm long usually much shorter. ..... Group *Nitorostris*

Paddle hair long, curved, *A* VII distinctly pointed, at least 0.5845 mm long, usually much longer. 2

2 Hair *C* II branched more than 10. ..... Group *Myzomyia*

Hair *C* II branched less than 10. 3

3 *A*-VI and *A*-VII more than half the lengths of segments VII and VIII respectively (at least 0.6 mm long, usually much longer). *K* I usually simple, sometimes split into 2. ..... Group *Pseudomyzomyia*

A-VI and *A*-VII half or less the lengths of the succeeding segments, respectively (at most less than 0.6 mm long, usually much shorter). *K* I usually 5-branched, range 3 to 9. ..... Group *Neocellia*.

In Table 1 the variations in the branching of the different hairs are shown.

The scheme used in designating the hairs and other parts of the pupa is shown in Plates 1 and 2. This is adapted from Senevet (1930-1932) as modified by Christophers (1933). Reference to the metathorax is by the capital letter "M" and to the abdominal segments by Roman numerals. Hairs on the metathorax and abdominal segment I may be referred to without the 'M' or the 'I' as *A*, *T*, etc., or they may be written *A*-M, *T* I, etc. The spines and other hairs are referred to with the corresponding segments as *A* II, *B* V, etc., but *C*-VI may be written merely *C* because this hair is present only on segment VI.

In the subgenus *Myzomyia* hair *S* is invariably branched and is the shortest and most internal of the three hairs situated at the anterolateral border of abdominal segment I. It is posterior to *T* but anterior to *U* in position. Senevet's conventional illustrations for *subjectus* Grass. and *vagus* Doenitz (1931, p. 40 and p. 74, respectively) are somewhat misleading, especially because his corresponding descriptions (p. 41 and p. 75, respec-

tively) "*S*, moyenne 3-4 branches" for *subpictus*, and "*S* . . . tres longue et simple" for *vagus*, do not agree with his illustrations. In a subsequent paper (1932) the character of *S* for *vagus* which Senevet presents is more in agreement with that for *vagus* var. *luzonus* of the Philippines, although the unusual simple *S* and 4-branched *T* of his specimen No. 4 have not been duplicated by any of the many specimens I have examined of the local species of the group *Pseudomyzomyia*.

For the local species of the subgenus *Myzomyia* the characters of *A*, *B*, and *C* are of specific and group values in many cases, in some very closely allied species *A* alone indicates differences between the forms. Branching of *A*, particularly *A*-VII, is common to all species except one in the group *Anomalomyia*, while splitting into two of *A* VII in group *Myzomyia* (especially in *mangyanus*) occurs with such frequency as to be considered a normal, though less common, peculiarity, but in the other groups *Neocellia* and *Pseudomyzomyia*—this happens very rarely and may therefore be taken as an abnormality. Duplication of a spine sometimes occurs. Normally there is a progressive increase in the length of the spines from the anterior to the posterior segments, the longest being *A* VII. Sometimes, however *A*-VI and, more rarely, *A* V are as long as or even longer than *A*-VII. Again a spine that is ordinarily short may attain a length entirely beyond its normal proportions or vice versa. But such abnormalities affect, so far as I have noted, only the spine of one side of a segment. Group *Pseudomyzomyia* possesses the longest spines, as can be seen in Table 2.

Of the parts of the paddle, the denticles (their relative sizes, and the extent of the external border they occupy), the presence or absence of accessory denticles on the anterolateral border of the paddle, and the length of the paddle hair are useful in differential diagnosis.

GROUP NEOMYZOMYIA

(Excluding *kolumbugoensis* of which we have no pupal material.)

As mentioned by Christophers (1933) and others, this group differs greatly from the other groups in the subgenus *Myzomyia*, and is similar to the subgenus *Anopheles* in having short paddle hair, and short, blunt spines.

TABLE [illegible] showing [illegible] in the [illegible] segments of the digestive tract.

Parts	Hairs	Group Myzomyia: Anopheles albimanus		Group Myzomyia: Anopheles bellator		Group Myzomyia: Anopheles nuneztovari		Group Neomyzomyia: Anopheles argyritarsis		Group Neomyzomyia: Anopheles rangeli	
		Range	Usual.	Range	Usual.	Range	Usual.	Range	Usual.	Range	Usual.
Metathorax	K	4–6	5	4–8	5	4–9	6	2–3	2	3–6	3
Do.	P	3–6	4	3	6	3–6	4	2	2	2–4	3
Do.	Q	4	3	2–5	4	2–5	3	2–3	2	3	3
Abdominal segment I	M	1–2		1–3	2	1–3	2	1–4	2	1–4	1
Do.	R	3–6	5	4–7		3–8	6	3–4	3	5–6	5
Do.	A	4–12	8	3–14	8	4–10	6	4–5	4	4–6	6
Do.	AP	4–8	6	4–9	5	4–7	6	2–3	3	5	6
Do.	Z	6–8	7	6–9	7	5–9	7	3–5	3	4–9	6
Do.	T	4–8	6	3–8	6	5–7	6	3–4	3	4	4
Do.	U	3–8	4	5–9	6	5–8	6	3–4	4	4–6	5
Abdominal segment II	C	10–18	14	7–33	21	12–25	16	3–14	9	11–16	12
Do.	D	1–2	2	1–2	2	1–4	2	2–3	2	3–5	4
Do.	E	3–9	6	5–10	8	4–9	6	2–5	3	5–6	5
Do.	F	3–8	6	5–8	6	3–7	5	3–6	4	6–8	6
Do.	G	3–8	6	5–14	9	5–9	6	3–4	3	5–6	5
Do.	H	3–6	5	5–8	6	3–5	4	2–3	2	4–5	4
Do.	I	4–8	6	6–9	8	5–8	6	4–6	5	6–12	9
Do.	J	1–3	2	2–4	3	2–4	3	1–2	1	2–3	2
Abdominal segment III	S	5–15	11	16–22	18	8–16	11	5–9	7	9–12	11
Do.		9–17	13	8–18	13	9–20	15	5–6	6	13–15	14
Do.	T	5–8	6	3–9	5	3–9	5	2–3	2	4–6	5
Do.	Z	3–9	5	4–9		3–7	4	3–4	4	5–6	4
Do.	S	4–6	4	4–9	7	4–9	6	2–3	3	3–4	3
Do.	4	4–10	8	7–14	9	7–12	9	3–4	4	6–8	
Do.	5		4	1–3	3	4				3	

TABLE I.—*Variations in the branching of palpal hairs in the subgenus Myzomyia.* Continued.

Part	Hairs	Group Pseudopalpopæ.													
		Anopheles indefinitus				*Anopheles vagus.*		*Anopheles fluviatilis*		*Anopheles barbirostris*		*Anopheles paraguayensis*			
		Fresh water		Salt water											
		Range.	Usual.	Range.	Usual.	Range.	Usual.	Range.	Usual.	Range.	Usual.	Range.	Usual.	Range.	Usual.
Metathorax	K	2–4	3	2–3	3	2–5	3	1–3	2	1–3	2	1–3	2	1–3	2
Do	P	2–5	3	2–4	3	2–5	3	2–4	3	2–4	3	2–5	3	2–4	3
Do	O	1–4	2	2	3	1–3	2	1–6	3	1–4	2	2–4	3	2–4	2
Abdominal segment I	H	1–4	2	2		1–2	1	1–2	1	1–2				1–1	1
do	K	3–8	5	4–7	5	3–5	5	3–7	4	3–4	4	5–9	7	4–9	6
Do.	L	5–10	8	6–9	7	5–6	6	5–8	6	6–7	6	7–12	10	6–8	7
Do	M	3	2	1–3	2	1–3	3	1–3	2	2	2	1–3	2	1–3	2
Do	S	3–8	6	3–8	5	4–7	6	2–6	3	3–5	4	4–10	8	3–8	6
Do	T	1		1	1	1–1	1	1–2	1	1–2	2	2		1–1	1
Do	U	1–4	1	1–1	1	1–1	1	1–2	1	1–2	2	1–4	2	1–2	1
Abdominal segment II	C	5–9	7	4–10	7	5–7	7	3–6	4	4–8	6	7–10	8	5–7	6
Do		1	1	1	1	1–1	1	1–3	1	1–3	2	1–1	1	1–2	1
Do		4–8	5	3–7	4	6–7	6	2–6	4	4–9	4	7–8	8	6–8	6
Do		3–6	5	3–6	4	3–5	4	1–2	2	2–4	3	5–6	6	5–5	5
Do		4–7	5	4–6	5	5–7	6	4–	5	4–7	6	7–		5–5	5
Do.		1–4	3	2–3	3	2–4	3	1–3	1	1–5	3	4–6	5	5–5	5
Do		6–12	9	6–9	7	4–7	6	3–6	5	5–8	6	9–9	9	6–6	6
Do		1	1	1	1	1	2	1	1	1	1	1	1	1–1	1
Abdominal segment III	B	5–8	6	4–8	5	5–7	6	3–6	5	4–9	6	9–11	10	8–9	8
Do	C	4–7	5	3–6	4	6–8	6	2–5	3	5–7	4	6–9	7	6–7	6
Do		3–7	5	3–6	3	2–4	3	1–3	2	2–3	2	3–6	4	3–6	3
Do.		4–9	6	5–9	5	4–6	5	6–8	5	4–8	6	7–8	7	4–7	5
Do		2–4	3	1–3	3	1–3	3	2–4	3	1–4	3	5–6	6	4–6	4
Do		6–8	7	4–9	7	5–8	7	3–5	4	3–7	5	7–7	7	6–7	6
Do		1	1	1	1	1	1		1	1–2	1	1–1	1	1–1	1

Abdominal segment IV	0	3-7	5	5-6	5	3-6	6	3-7	5	3-6	5	5-8	7
Do.	[illegible]	2-6	4	1-6	4	3-6	3	4	4	7		6-9	7
Do.		3-5	2	1-4	2	1-3	2	2	1			1-3	4
Do.	2	3-8	5	4-8	6	4-8	4	4-7	6	6-7	6	4-6	6
Do.	3	4-	6	6	6	6-7	6	4-7	6	5-7	6	5-8	7
Do.	4	4-7	6	5-7	6	3-5	4	3-6	5	2-4	3	5-7	5
Do.	5	1-1		1-1	1	1	1	1	1	1	1	1	
Abdominal segment V	0	4-6	4	3-6	5	4-6	6	4-6	4	3-6	4	4-6	4
Do.	[illegible]	1		1-2		1-2		2		1		1	1
Do.	1	2-6	3	2-5	3	2-3	3	1-	1	1		3-4	4
Do.	2	3-6	4	2-6	4	3-5	4	3-5	3	3-5	4	6	5
Do.	3	1-3	2	1-3	2	1-4	3	1-3	2	1-3	2	4	3
Do.	4	3-7	5	3-4	4	2-4	4	1-4	3	3-4	4	4-7	6
Do.	5	1-1	1	1		1-1	1	1-1	1			2	
Abdominal segment VI	0	3-4	3	3-6	5	3-6	4	2-6	3	3-6	4	3-5	4
Do.	[illegible]	1-1	1	1-	1	2	1	1-1	1			1-1	1
Do.	2	2-4	3	4	3	3	2	1-3	2	1-4	3	3-6	3
Do.	1	2-4	3	2-3	2	2-3	2	1-1		1-2	1	3-5	4
Do.	3	1-6	3	2-3	3	1-3	3	1-1	1	1-2	1	4	3
Do.	4	3-6	5	3-5	4	3-4	3	1-2	2	2-3	3	4-6	5
Do.	5	1		1-1		1	1	1	1	2		1-1	1
Abdominal segment VII	0	2-4	3	2-5	3	4-5	5	2-6	3	3-5	4	2-5	3
Do.	[illegible]		1	1-1		1-1	1	1-		1-1	1	1	1
Do.	1	2-4	3	2-4	2	2-3	2	1-3	2	1-3	1	1	2
Do.	2	1-3		1-2		1-2	1	1-2	1	1-3	1	1-4	2
Do.	3	2-5	4	3-5	4	3-4	3	2-4	3	2-4	3	2-3	3
Do.	4	3-6	4	3-4	4	3-4	4	1-3	2	6	3	4-7	4
Do.	5	1		1-1		1		1	1	1-2		1-1	1
Abdominal segment VIII	[illegible]	9-13	11	8-16	[illegible]	22	4	9-16	15	7-16	12		10
Do.	[illegible]	1-3	2	1-2		2	2	1	1	2	1	3-3	3
Do.	[illegible]			1	1		1	1	1	1-1	1	1-1	1
Paddle	[illegible]	1-1						1-1	1	1-1	1	1-1	1
Do.	[illegible]	1-4	3	2-5	3		1	1-3	2	2-3	2	3-6	5

TABLE 2.—*Lengths of prepupal spiracles in species of the subgenus Myzomyia*

[Figures are fractions of a millimeter.]

Species and strain	Stage III			Stage IV		
	Range	Average	Commonest	Range	Average	Commonest
Myzomyia						
Anopheles aitkeni	0.0384–0.0768	0.0625	0.0576	0.0668–0.0864	0.0780	0.0864
Anopheles annularis var. *flavirostris*	0.0384–0.0864	0.0625	0.0576	0.0864–0.1152	0.0945	0.0960
Anopheles campestris	0.0384–0.0576	0.0500	0.0480	0.0768–0.0960	0.0872	0.0864
vagus						
Anopheles barbirostris	0.0288–0.0480	0.0384	0.0384	0.0576–0.0768	0.0672	0.0672
Anopheles philippinensis	0.0384–0.0768	0.0576	0.0576	0.0768–0.0960	0.0864	0.0864
Anopheles karwari	0.0288–0.0384	0.0336	0.0336	0.0576–0.0768	0.0672	0.0672
Anopheles subpictus	0.0384–0.0576	0.0480	0.0480	0.0768–0.0960	0.0864	0.0864
vagus-group						
Anopheles vagus	0.0672–0.0864	0.0768	0.0768	0.0960–0.1152	0.1056	0.1056
Anopheles var. *bataanensis*	0.0768–0.0960	0.0864	0.0864	0.1152–0.1344	0.1248	0.1248
Anopheles indefinitus	0.0384–0.0576	0.0480	0.0480	0.0768–0.0960	0.0864	0.0864
Anopheles rivulorum	0.0384–0.0576	0.0480	0.0480	0.0768–0.0960	0.0864	0.0864
Anopheles rivulorum, var.	0.0384–0.0576	0.0480	0.0480	0.0768–0.0960	0.0864	0.0864
Pseudomyzomyia						
Anopheles indefinitus, fresh water	0.0384–0.0768	0.0576	0.0576	0.0768–0.0960	0.0864	0.0864
Anopheles indefinitus, salt water	0.0384–0.0768	0.0576	0.0576	0.0768–0.0960	0.0864	0.0864
Anopheles umbrosus	0.0384–0.0576	0.0480	0.0480	0.0768–0.0960	0.0864	0.0864
Anopheles litoralis	0.0384–0.0576	0.0480	0.0480	0.0768–0.0960	0.0864	0.0864
Anopheles indefinitus	0.0384–0.0576	0.0480	0.0480	0.0768–0.0960	0.0864	0.0864
Anopheles parangensis	0.0384–0.0576	0.0480	0.0480	0.0768–0.0960	0.0864	0.0864

Group and species.	[illegible]			[illegible]			[illegible]		
	Range.	Average.	Commonest.	Range.	Average.	Commonest.	Range.	Average.	Commonest.
Myzomyia									
Anopheles hispaniola	0·3833–0·4179	0·3916	0·3833	0·3333–0·3810	0·3563	0·3571	0·3571–0·3810	0·3682	0·3947
Anopheles minimus var. *flavirostris*	0·3571–0·4615	0·3955	0·3810	0·3846–0·4167	0·4021	0·4000	0·3810–0·4000	0·3857	0·3810
Anopheles sundaicus	0·3846–0·4348	0·4047	0·3913	0·3571–0·3947	0·3742	0·3704	0·3704–0·3966	0·3879	0·3810
Neomyzomyia									
Anopheles annularis	0·3340–0·3684	0·3529	0·3529	0·3333–0·3636	0·3496	0·3333	0·3333–0·3571	0·3416	0·3333
Anopheles philippinensis	0·4333–0·4615	0·4500	0·4333	0·4333–0·4615	0·4500	0·4333	0·4333–0·4615	0·4476	0·4615
Anopheles sinensis	0·3913–0·4167	0·4054	0·4000	0·3913–0·4167	0·4054	0·4000	0·3913–0·4167	0·4080	0·4000
Anopheles vagus	0·5833–0·6316	0·6076	0·6000	0·6316–0·6667	0·6530	0·6364	0·6316–0·7316	0·7026	0·7188
Neocellia									
Anopheles leucosphyrus	0·2174–0·2632	0·2402	0·2308	0·2308–0·2500	0·2389	0·2389	0·2000–0·3077	0·2773	0·3170
Anopheles n. var. *Banksiensis*	0·3214–0·4348	0·3724	0·3684	0·3571–0·4545	0·3904	0·3667	0·3170–0·4091	0·3833	0·3olo
Anopheles recidens	0·3478–0·4737	0·4315	0·4286	0·3846–0·4091	0·4000	0·4074	0·3810–0·4762	0·4362	0·4706
Anopheles vorax	0·1666–0·1765	0·1689	0·1667	0·2000–0·2381	0·2208	0·2000	0·2000–0·2500	0·2259	0·2500
Anopheles vossi	0·0588–0·1000	0·0769	0·0769	0·0952–0·1053	0·1003	0·1053	0·1053–0·1250	0·1125	0·1053
Pseudomyzomyia									
Anopheles subcristatus, fresh water	0·5000–0·6842	0·6313	0·6316	0·7143–0·8000	0·7857	0·8000	0·7368–0·8889	0·8223	0·8182
Anopheles tulagiensis, salt water	0·7368–0·8750	0·8150	0·7778	0·8421–0·8571	0·8511	0·8571	0·8889–0·9231	0·9237	0·9286
Anopheles hyrcanus	0·5333–0·6316	0·6001	0·6000	0·8000–0·8571	0·8357	0·8667	0·8571–0·9286	0·8911	0·8571
Anopheles litoralis	0·6316–1·0000	0·8368	0·8000	0·8824–1·0000	0·9425	0·8966	0·8824–1·0000	0·9024	1·0000
Anopheles bataviensis	0·3333–0·5000	0·4018	0·3810	0·4286–0·5000	0·4620	0·5000	0·4000–0·5000	0·4680	0·4762
Anopheles paraannulatus	0·6842–0·7500	0·7206	0·6842	0·8000–0·8571	0·8260	0·8000	0·8571–0·9000	0·8743	0·8667

Curiously *cristatus*, which is different in the larval stage from the other species of the group, does not in the pupal stage possess any peculiarity that will readily segregate it from the rest. On the contrary, var. *balabacensis* whose larva is very much like that of *leucosphyrus* can easily be recognized in the pupal stage, for its relatively long spines particularly those on segment IV. By average values A–IV of var. *balabacensis* is about four times as long as the corresponding spine of the other species. Except in *tessellatus* branchings of the spines are usually found at least on *A* VII. Branchings on *A* V to *A* VII are usually present in var. *balabacensis*, *cristatus* and *kochi*, occasional branching is present also on *A* IV of var. *balabacensis*, while sometimes *leucosphyrus* does not have any branches, even on *A*–VII. By normal occurrence and by average values, the spines of *kochi* and *tessellatus*, especially those on segments V and VI are shorter than those of the other species under the group.

For the related *leucosphyrus* forms the reader is referred to part IV of these Notes.

Key to the species of group Neomyzomyia, based on pupal characters

1	*A* IV at least 0.67 mm long, usually longer	*leucosphyrus* var. *balabacensis*
	A IV much less than 0.167 mm. long	2
2	*A* V at least 0.2 mm long, usually much longer	3
	A V much less than 0.2 mm long	4.
3	At least *A* VI and *A* VII with branches	*cristatus*
	Branchings of spines present only on *A*–VII and probably also *leucosphyrus* var. *viparis*	*leucosphyrus*
4	*C* simple *B*–V and *E* VII branched 3 to 5 and 2 or 3 respectively	*kochi*
	C branched 6 to 8 *B* V and *B* VII branched 8 to 12 and 6 to 10 respectively	*tessellatus*

GROUP MYZOMYIA

The three species of this group are hard to separate in the pupal stage. By average values in lengths of the spines it may be possible to differentiate *mangyanus* quite readily, but average values have very limited practical usefulness. The following key is offered merely as a general guide in differentiating the pupae of the three species.

Key to the species of the group Myzomyia, based on pupal characters

1	*A* IV from 0.5 to 0.7 mm. average 0.6 mm long *A* III usually over twice the length of *A* II	*mangyanus*
	A IV from 0.26 to 0.5 mm average 0.39 mm long *A* III usually less than twice as long as *A* II	2

B-III usually with less than 10 branches; B-VII branched around 4; A-II distinctly blunt — *flavirostris*

B-III with at least 10 branches, B-VII branched around 7, A-II usually pointed — *minimus* var. *flavirostris*

Branching of A-VII whenever present is by simple splitting of the spine into two, as like that in the species of the group *Neomyzomyia* where more than one branch are usually present on each spine, the branches however, in the group *Myzomyia* are often much longer than in the group *Neomyzomyia*. The highest percentage of branching on A-VII in the group *Myzomyia* is among specimens of *mangyanus*, of which 19 per cent in our series have this peculiarity

GROUP PSEUDOMYZOMYIA

Following Morishita's opinion (1933 which was previously indicated by King (1931), *Anopheles indefinitus* is here considered specific in status instead of being a variety of *subpictus*. But whether or not the local forms of fresh- and salt-water *indefinitus* are distinct from each other is yet to be determined by studies on their eggs. Walch and Walch-Sorgdrager (1934) have shown from egg characters that fresh- and salt-water *subpictus* in Netherland India are different from each other. It can hardly be expected that differences in the two local forms of *indefinitus* could be found in the pupal stage when even distinct species under the group are very similar in this stage. Moreover, King (1931) and others have found no difference between these forms in the larval or adult stages.

The peculiar case reported by Sen (1930) of a female *Anopheles vagus* from whose eggs larvae and adults of both *vagus* and *subpictus* types were produced, if proved correct by further experiments, will cause drastic changes in the classification of the group, and possibly a return to the old usage of vagus as embracing all these mixed forms. Sen's discovery will throw some doubt on the best methods of classification. However, as reported by Walch and Walch-Sorgdrager (1934) there is a big difference between the eggs of *subpictus* and of *vagus* in Netherland India (which is likely true also in the Philippines), while in India Christophers and Barraud (1931) found the eggs of these two species very much alike. It may be supposed, therefore, that the two forms are not as distinctly seperated genotypically in India as they are in other places, which makes possible the occurrence of such a case as noted by Sen. Otherwise the interracial sterility of such less distinguishable forms (mor-

phologica ly) as certain varieties of *maculipennis* reported by de Buck Schoute, and Swellengrebel (1914) cannot be understood, since the distinctly different forms (morphological, *sub pictus* and *vagus*) are fertile.

Of the species under group *Pseudomyzomyia*, *A. murangensis* alone possesses fairly marked characteristics, the others are very similar in characters.

Key to the species of group Pseudomyzomyia based on pupal characters

1. Paddle has two-thirds or more the length of paddle, *R*–M and *C*–IV usually 7-branched (range 5 to 8 and 6 to 10, respectively) ..... *parangensis*.
   Paddle hair less than two-thirds (usually less than half) the length of paddle, *R*–M and *C*–IV branched less than 7 (range 1 to 5 and 2 to 6, respectively) 2
2. Hairs *T*, *I* and external 1–II fairly stout and extend to or beyond apex, 1–IV usually 3-branched (range 2 to 4) ..... *subpictus*
   Hairs *T*, *I* and external 1–II more slender, usually curved, 1–IV usually simple (range 1 to 3) 3
3. Accessory denticles on anterointernal border of paddle strong and well developed ..... *indefinitus*
   These denticles few and indistinct 4
4. 1–IV 2- or 3-branched, *C*–IV usually 3-branched (range 3 to 4) ..... *vagus* var. *immaculatus*
   1–IV simple, *C*–IV usually simple ..... *literatus*.

GROUP NEOCELLIA

The group *Neocellia* is included in part V of these Notes.

SUMMARY AND CONCLUSIONS

1. Pupal characters of the species of the subgenus *Myzomyia* are presented.

2. It is shown that the groups can be readily separated, but the species under certain groups are very much alike and can hardly be differentiated from one another, the keys for such groups are given merely as general guides.

3. It is indicated that probably the best method of classifying Philippine species of *Anopheles* is by a combination of the characters in all stages such as those found in the eggs, larvæ, pupæ, and adults. It is also indicated that probably the Indian forms of *subpictus* and *vagus* are not identical with *subpictus* and *vagus* of Netherland India, and the Philippines, those of India are apparently more closely related than those of other places, which makes possible the peculiar case reported by Sen. If this is correct, crosses between *indefinitus* and *vagus* var.

mosquitoes in the Philippines probably do not take place, or if they do the resulting eggs or progenies are very likely sterile

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ILLUSTRATIONS

The illustrations were drawn with the aid of a camera lucida the respiratory trumpets from unmounted specimens all the others from flat preparations.

PLATE 1 ANOPHELES FILIPINÆ MANALANG

Parts of metathorax and abdominal segments I II and VI Designation of parts, hairs, and spines applies to corresponding parts hairs and spines of other illustrations. *R P* and *O* hairs of metathorax *H K L M S, T* and *U* hairs of abdominal segment I *t* is the base of tendriole *ft* 4, spine *C* large dorsal hair of abdominal segment II 1–4 2–3 3 4 and 5 other dorsal hairs of abdominal segment II 4 spines *as, C,* and *C'* large dorsal hairs of abdominal segment VI 1, 2, 4, and 5 other dorsal hairs of abdominal segment VI

PLATE 2 ANOPHELES FILIPINÆ MANALANG

1. Respiratory trumpet
2. Paddle and part of abdominal segment VIII Designation of parts, hairs, and spine applies to corresponding parts, hairs, and spine of other illustrations. *A*, spine *A'* accessory hair of spine 5 dorsal hair of abdominal segment VIII *e*, external border of paddle, other parts of paddle as labeled.

PLATES 3 AND 4 ANOPHELES MINIMUS VAR. FLAVIROSTRIS LUDLOW

PLATES 5 AND 6 ANOPHELES MANCHURICUS BANKS

PLATE 7 PUPAL SPINES III TO VII

Fig. 1 *Anopheles minimus* var. *flavirostris* Ludlow
2 *Anopheles filipinæ* Manalang
3 *Anopheles manchurianus* Banks

PLATES 8 AND 9 ANOPHELES INDEFINITUS LUDLOW

PLATES 10 AND 11 ANOPHELES VAGUS VAR. LIMOSUS KING

PLATES 12 AND 13 ANOPHELES LITORALIS KING

PLATES 14 AND 15. ANOPHELES LUDLOWI THEOBALD

PLATES 16 AND 17 ANOPHELES PARANENSIS LUDLOW

PLATE 18 PUPAL SPINES III TO V

Fig. 1 *Anopheles ludlowi* Theobald
2 *Anopheles litoralis* King
3 *Anopheles paraneusis* Ludlow
4 *Anopheles vagus* var. *limosus* King
5. *Anopheles indefinitus* Ludlow

PLATES 19 AND 20. ANOPHELES KOCHI DÖNITZ

PLATES 21 AND 22. ANOPHELES TESSELLATUS THEOBALD

PLATE 23. PUPAL SPINES IV TO VII

FIG. 1. *Anopheles leucosphyrus* var. *balabacensis* Baisas.
2. *Anopheles leucosphyrus* var. *balabacensis* Baisas, showing much longer A IV.
3. *Anopheles kochi* Dönitz.
4. *Anopheles leucosphyrus* Dönitz.
5. *Anopheles tessellatus* Theobald.
6. *Anopheles crustatus* King and Baisas, showing unusually long A IV.
7. *Anopheles crustatus* King and Baisas, showing normal A IV.

PLATE 24. DUPLICATION AND SPLITTING OF PUPAL SPINES

FIG. 1. *Anopheles leucosphyrus* var. *balabacensis* Baisas.
FIGS. 2, 3, and 4. *Anopheles litoralis* King.
FIG. 5. *Anopheles vagus* var. *limosus* King.
6. *Anopheles filipinae* Manalang.
Anopheles minimus var. *flavirostris* Ludlow.
8. *Anopheles manguinus* Banks.

PLATE 25. DENTICLES AND ACCESSORY DENTICLES OF PADDLE

FIG. 1. *Anopheles ludlowi* Theobald, anterolateral border of paddle.
2. *Anopheles litoralis* King, anterolateral border of paddle.
FIGS. 3 and 4. *Anopheles ludlowi* Theobald.
FIG. 5. *Anopheles vagus* var. *limosus* King.
6. *Anopheles litoralis* King.
7. *Anopheles indefinitus* Ludlow.
8. *Anopheles barangensis* Ludlow.

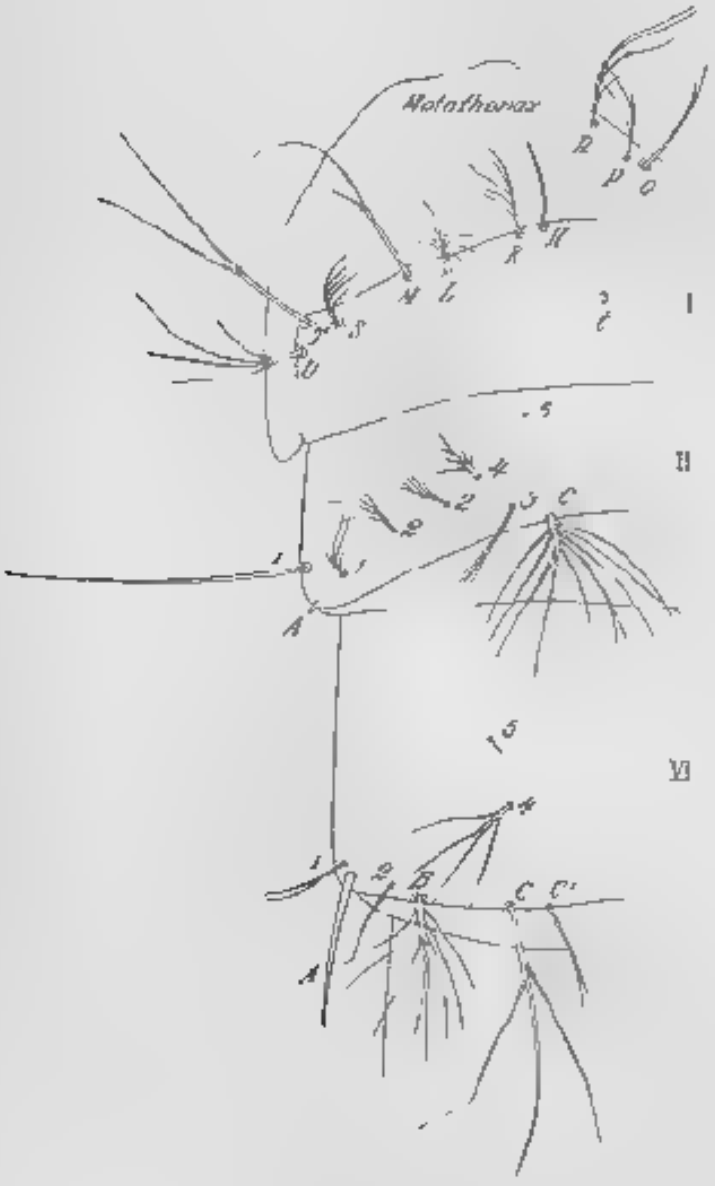


PLATE ANOPHELES FILIPINÆ

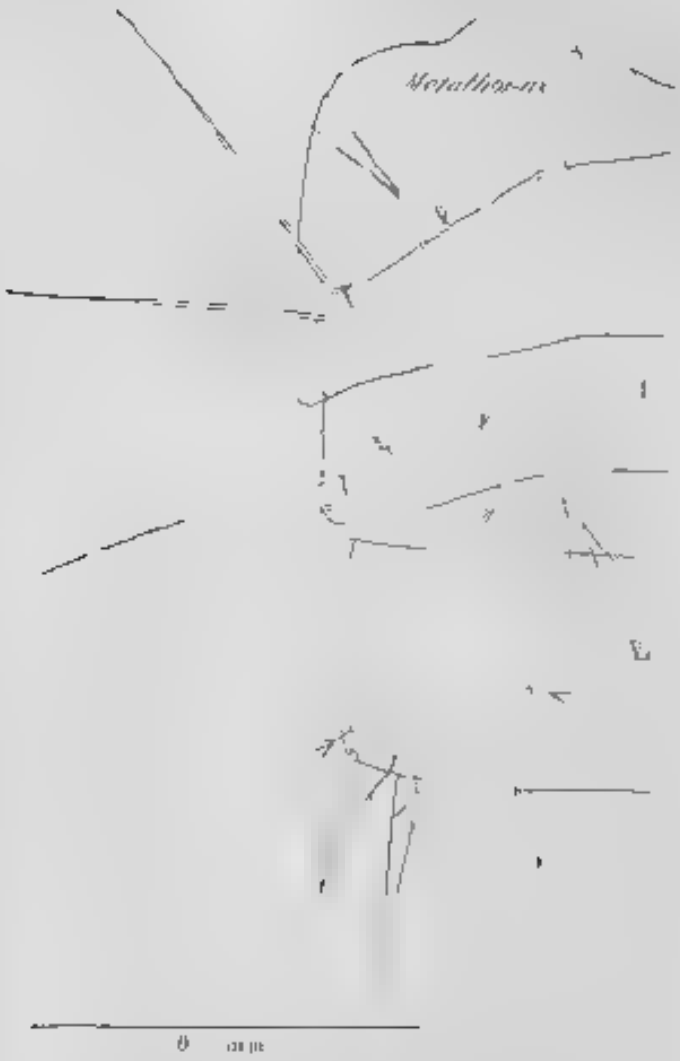


PLATE 8 ANOPHELES INDEX MAPS

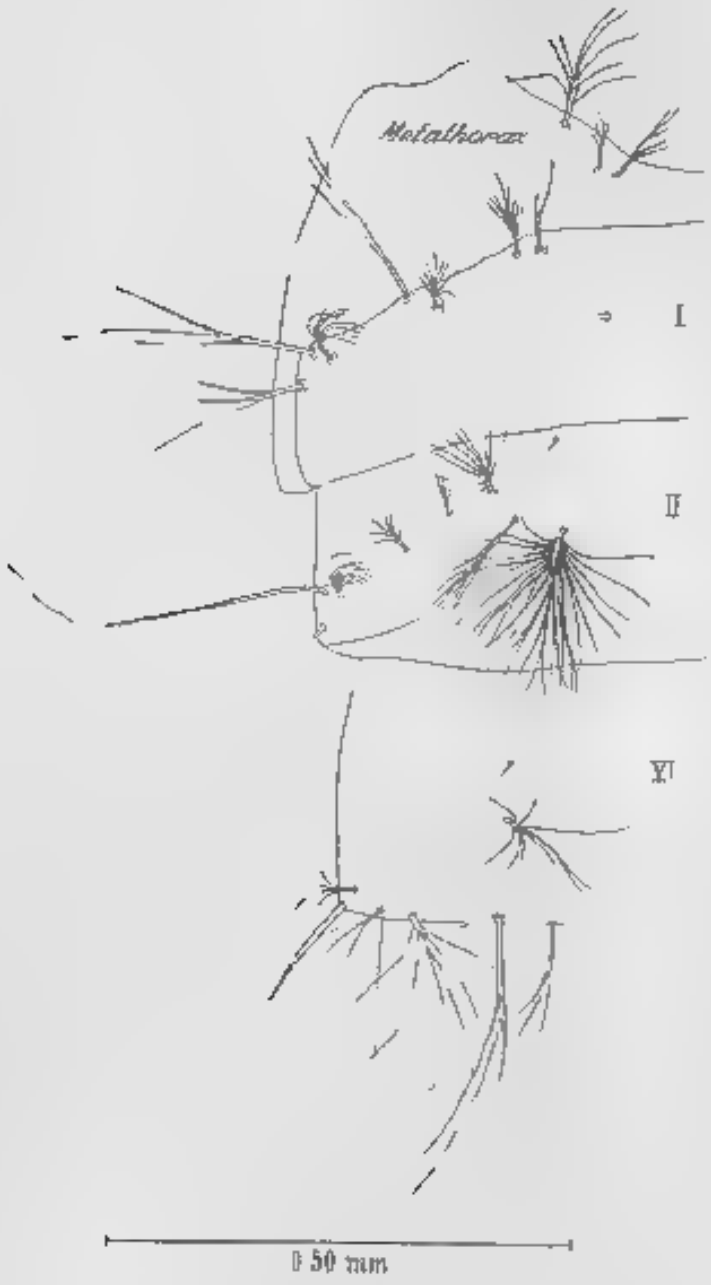


PLATE 3. ANOPHELES MINIMUS VAR. FLAVIROSTRIS


0 50 mm

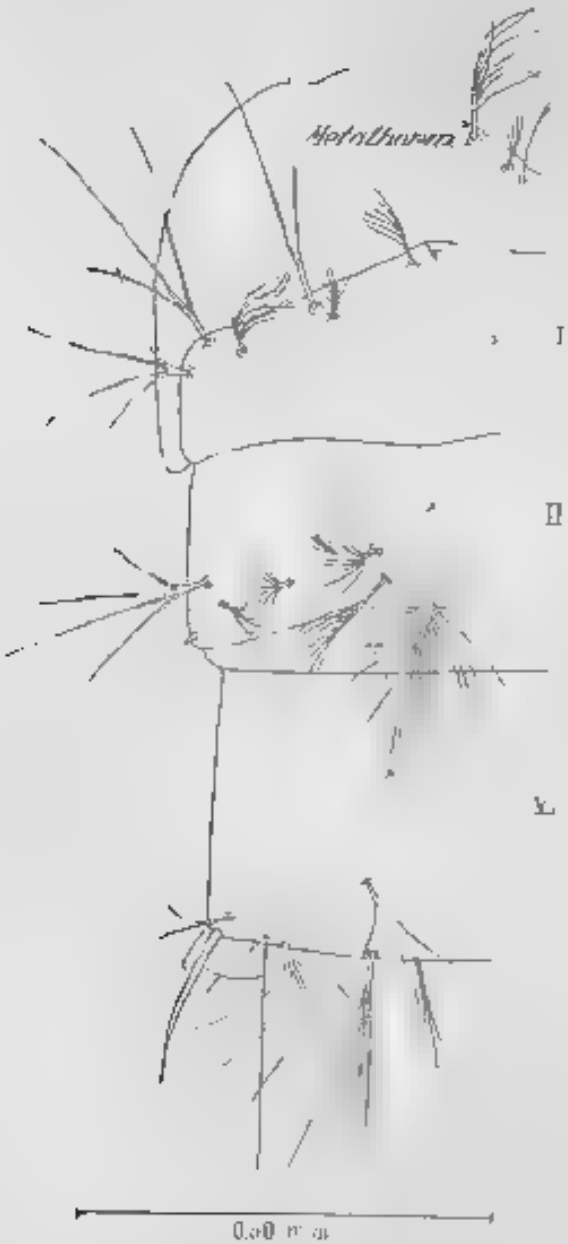


PLATE ANOPHELES MANGANUS

PLATE 6. ANOPHELES MANGYANUS

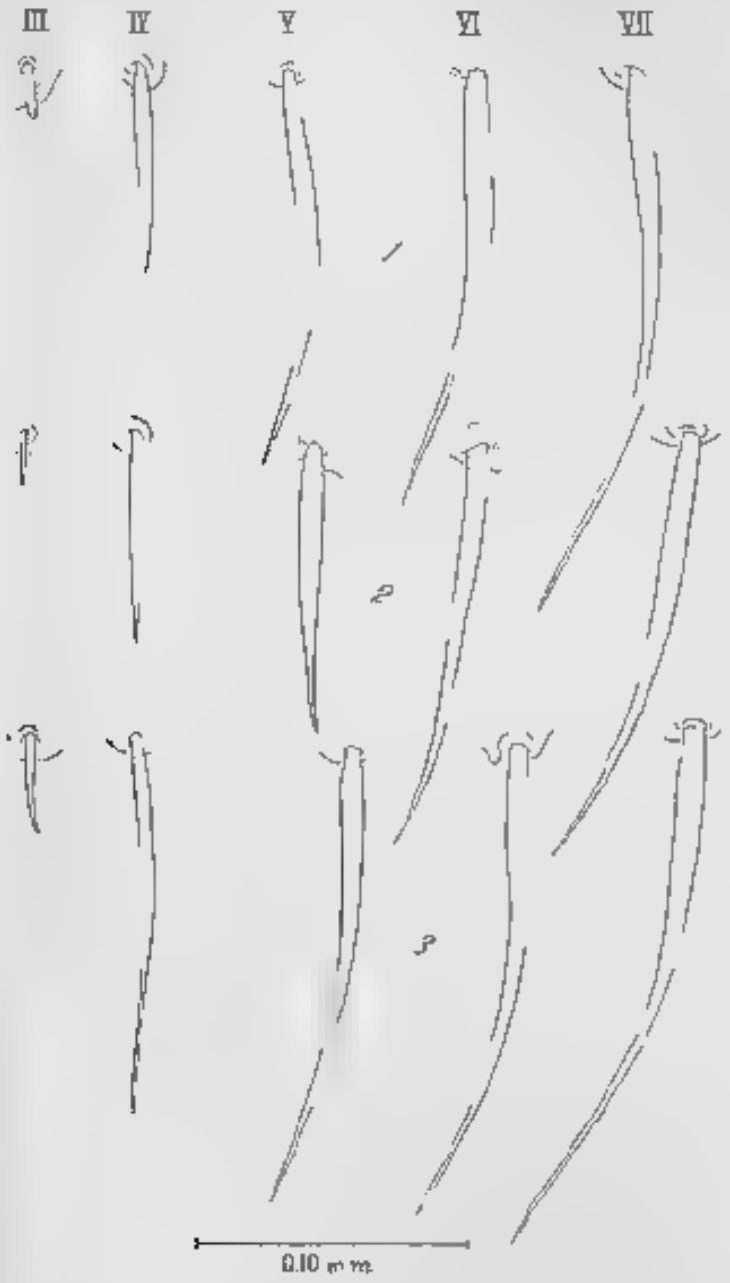


PLATE 7 PUPAL SPINES III TO V GROUP MYZOMYIA

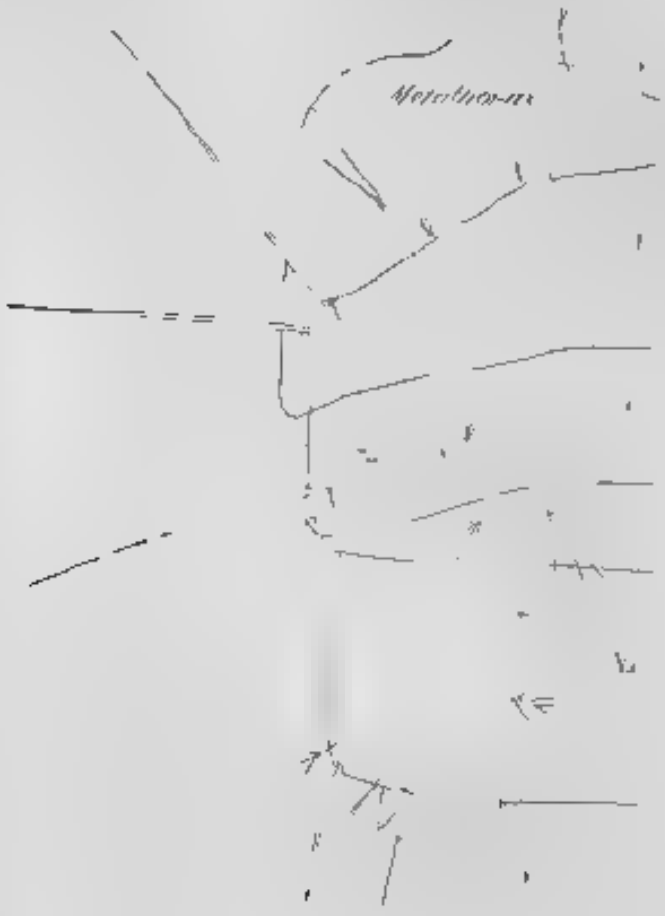


PLATE 8 ANOPHELES NDEF N TLS

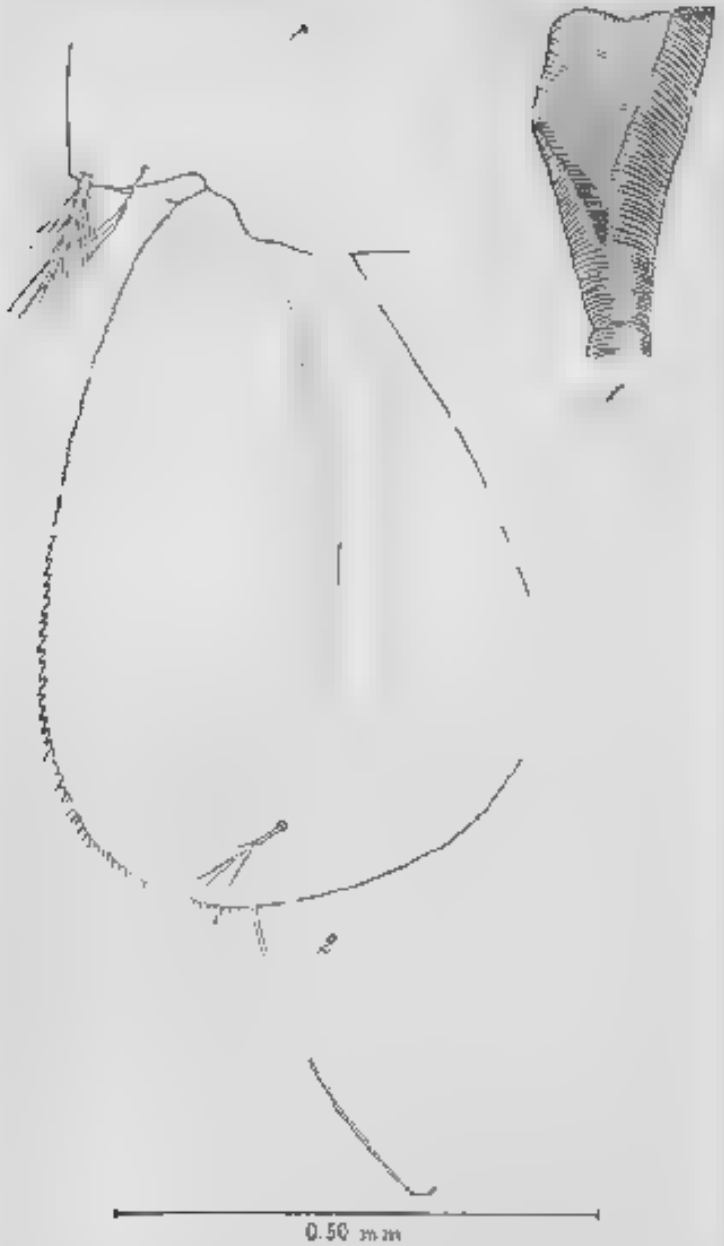


PLATE 8. ANOPHELES NDEFIN TUB.

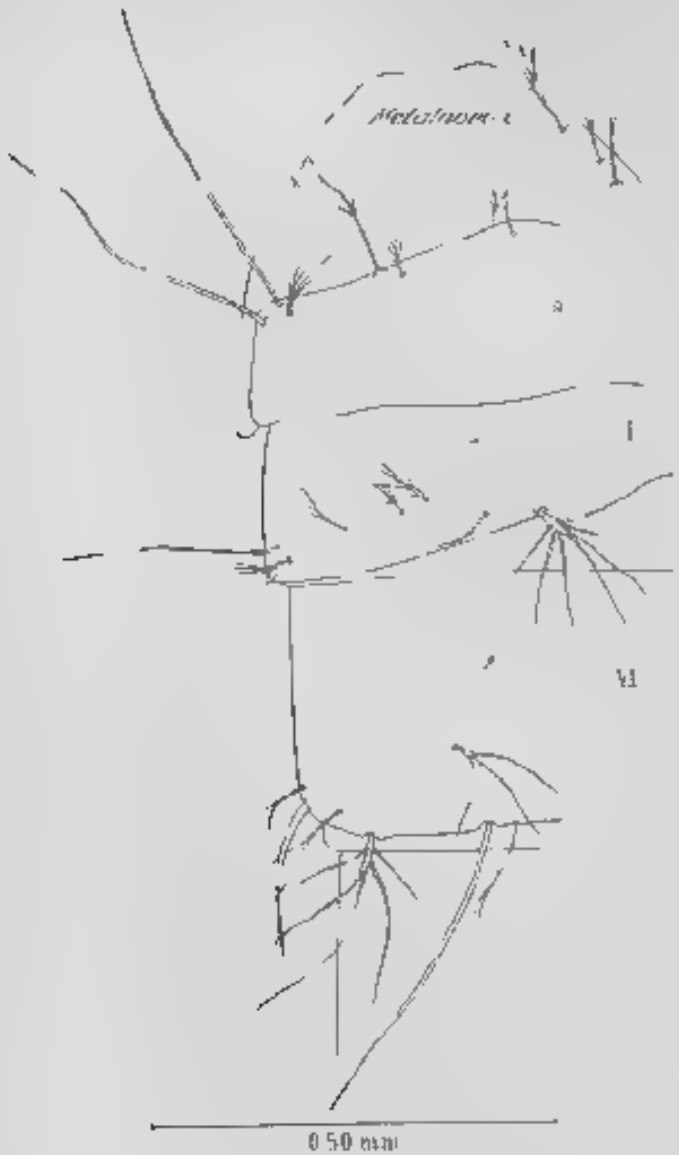
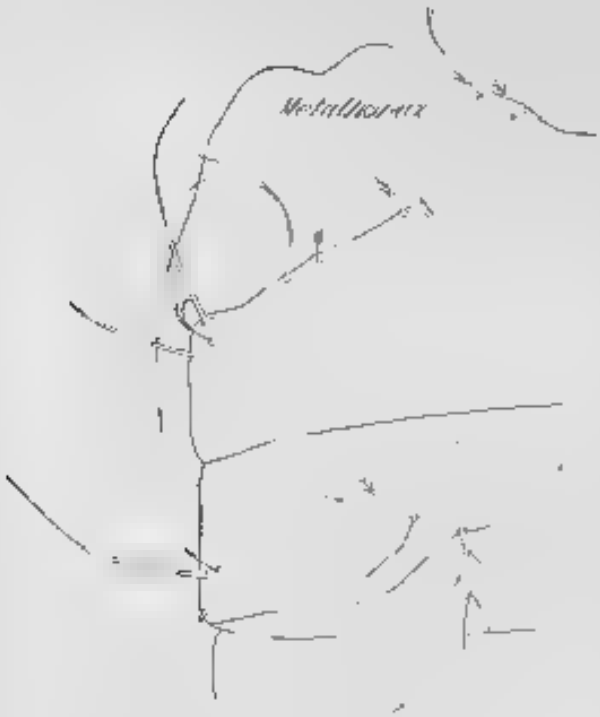


PLATE 8. ANOPHELES VAGUS VAR LIMOSUS

0 50 mm

PLATE ANOPHELES VAGUS VAR. L MUSUS



VI

0.5 mm

PLATE 2 ANOPHELES LITORALIS

PLATE 3 ANOPHELES (TORALIS

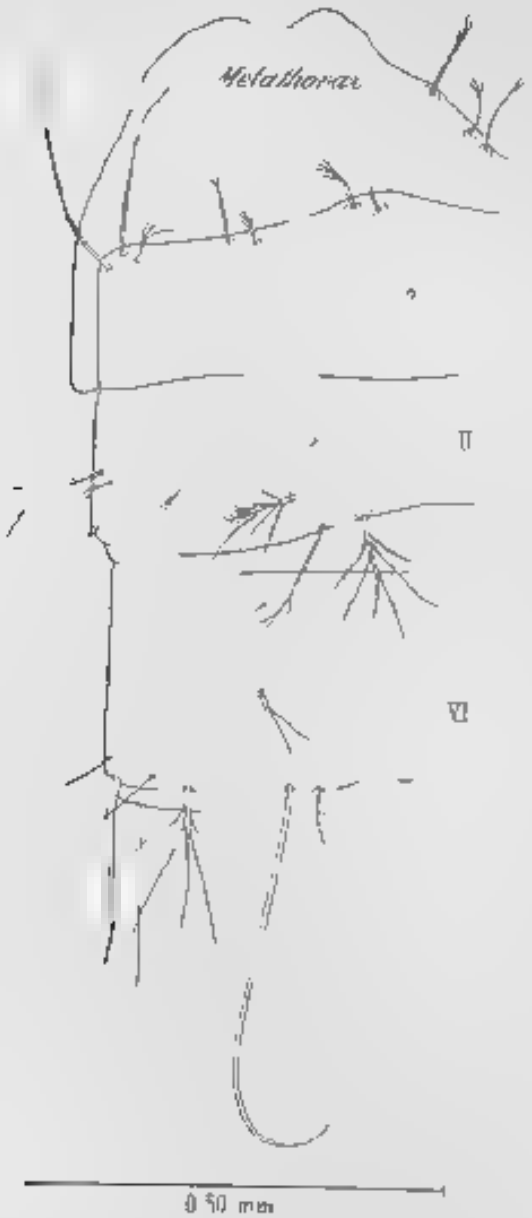


PLATE 4 ANOPHELES LELOW

PLATE 8. ANOPHELES LUDLOWI

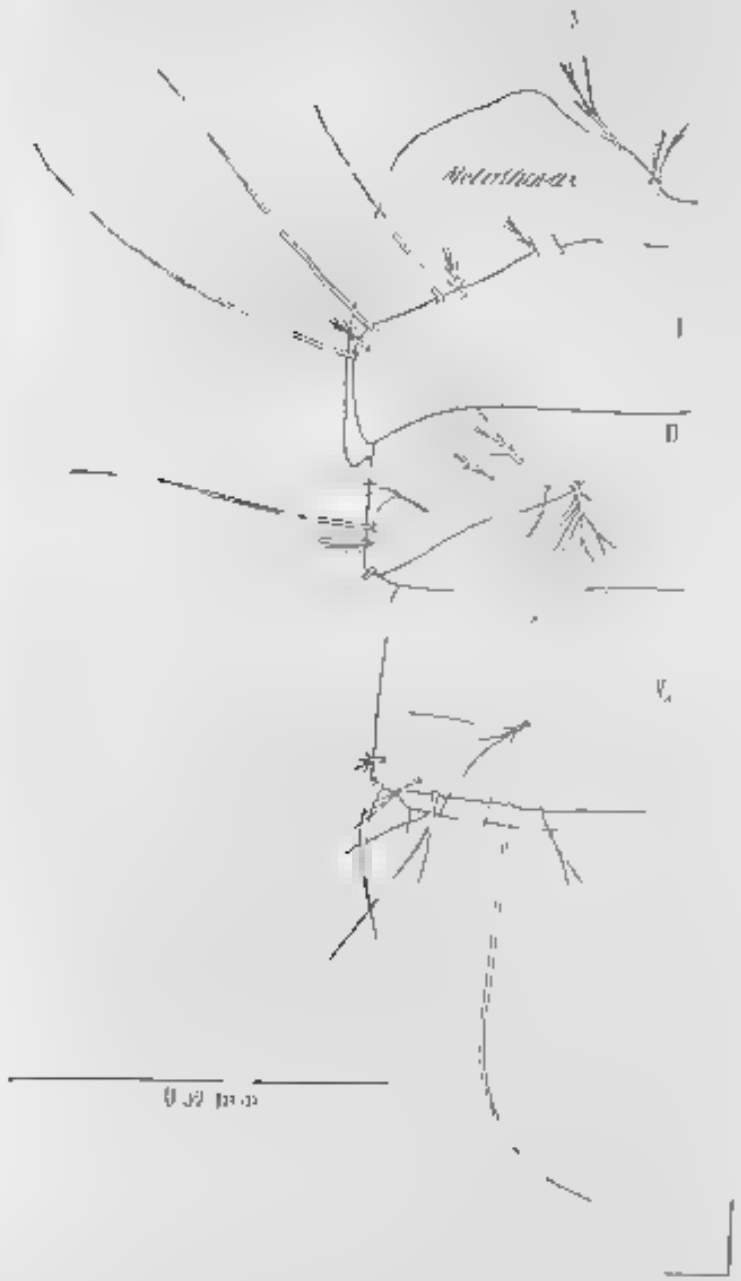


PLATE 16 ANOPHELES BARANGENSIS

PLATE 2. ANOPHELES PARANGENS S.

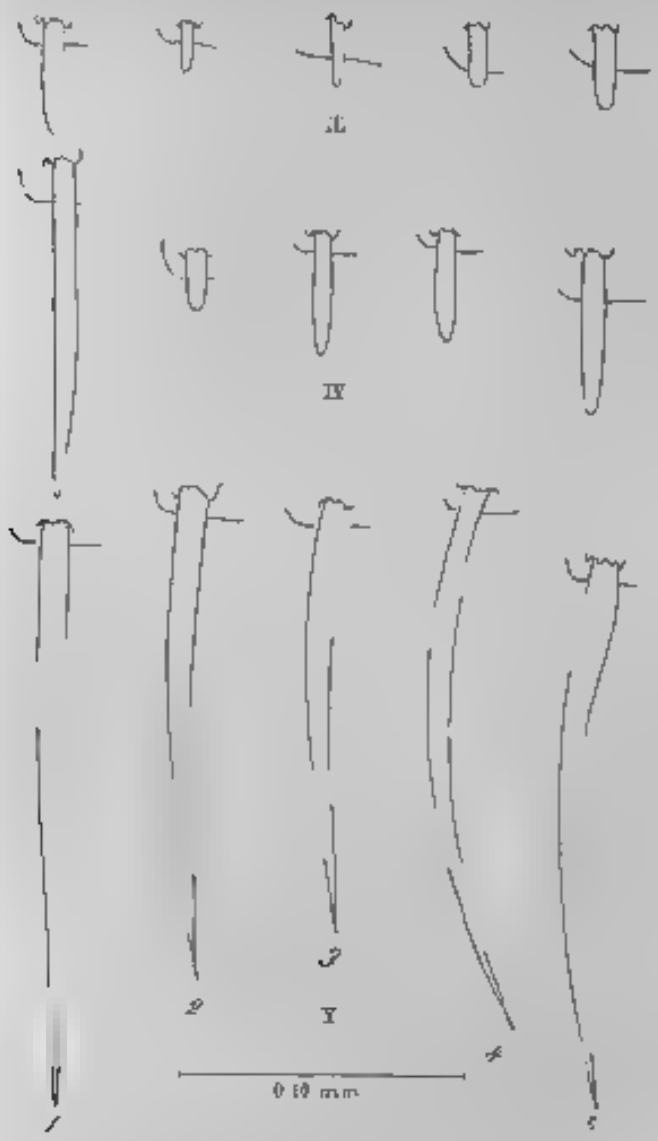


PLATE 18 PUPAL SPINES III TO V GROUP PSEUDOMYZOMYIA

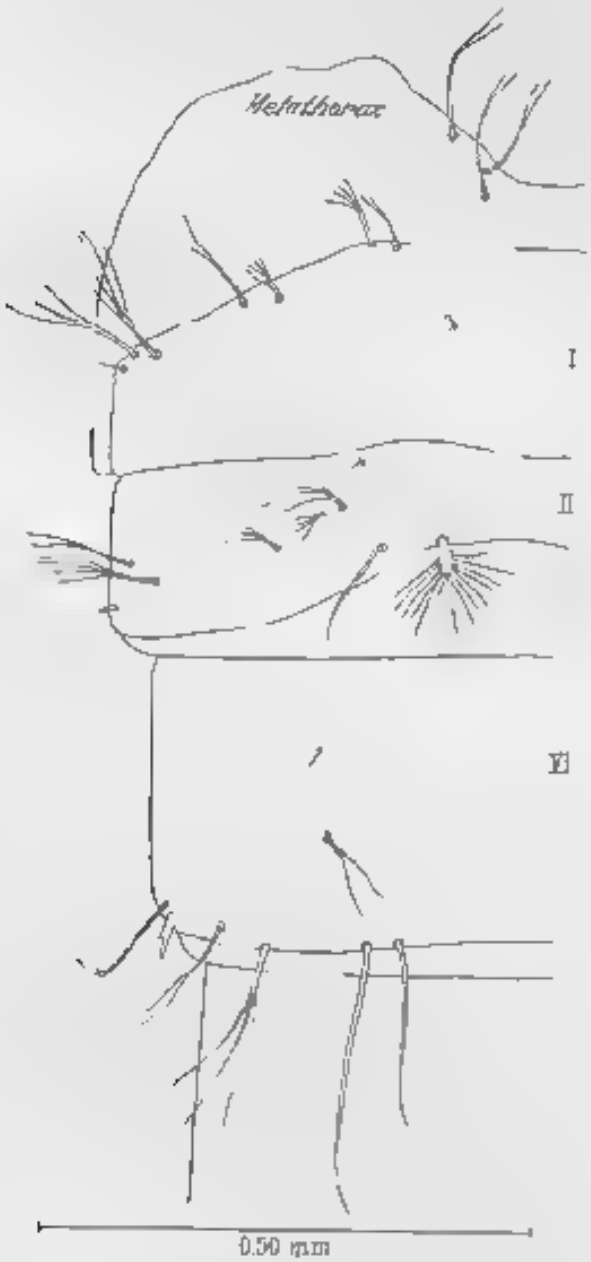


PLATE 9. ANOPHELES KOCH

PLATE 9 ANOPHELES KOCHI

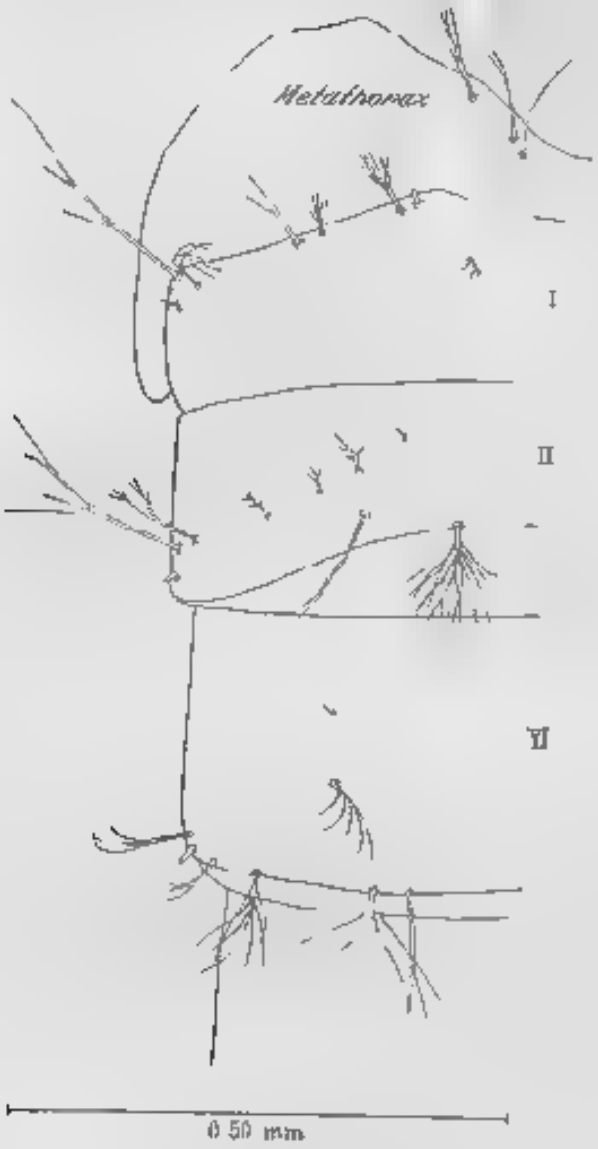


PLATE 7 ANOPHELES TESSELLATUS

0.50 mm

PLATE 3 ANOPHELES TESSELLATUS

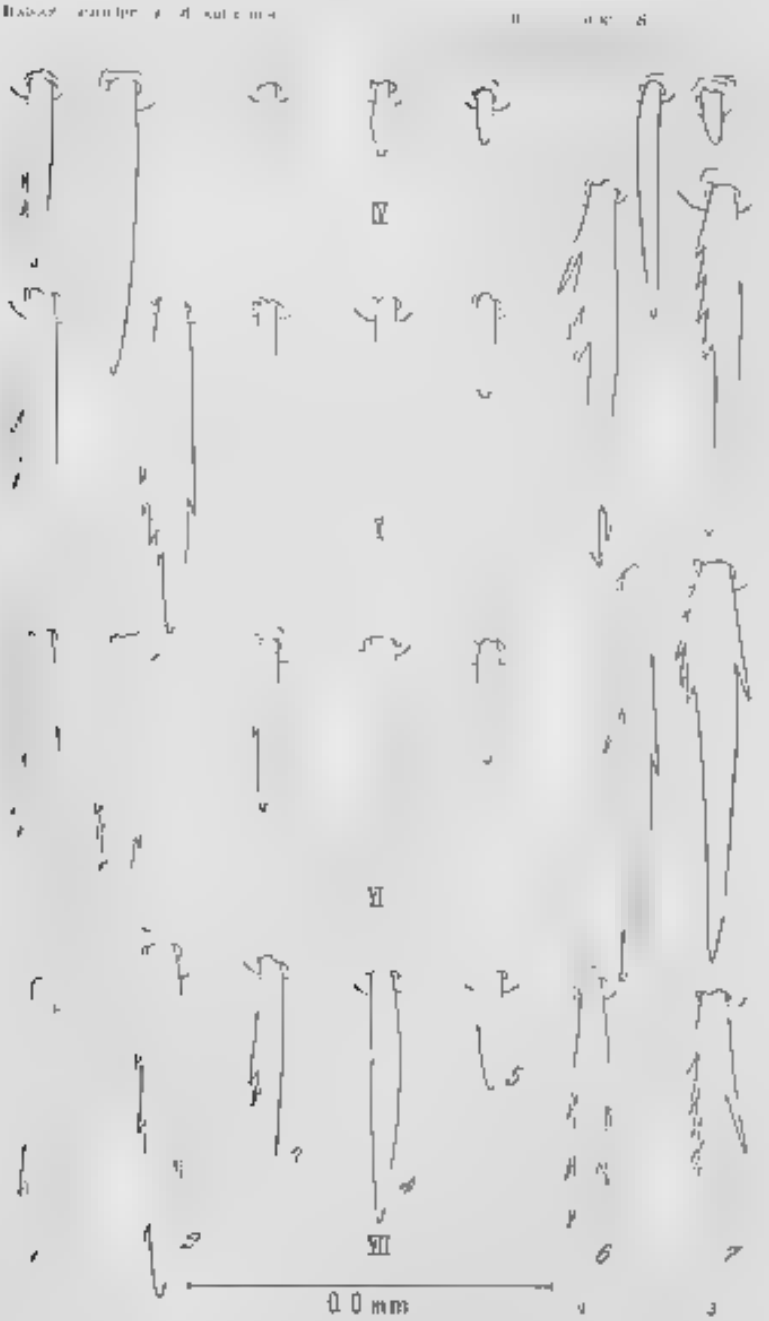


PLATE 33 PUPAL SPINES 1 TO 13 GROUP NEOMYZUM A

PLATE 31. DUPLICATION AND SPLITTING OF DUPAL SPINES

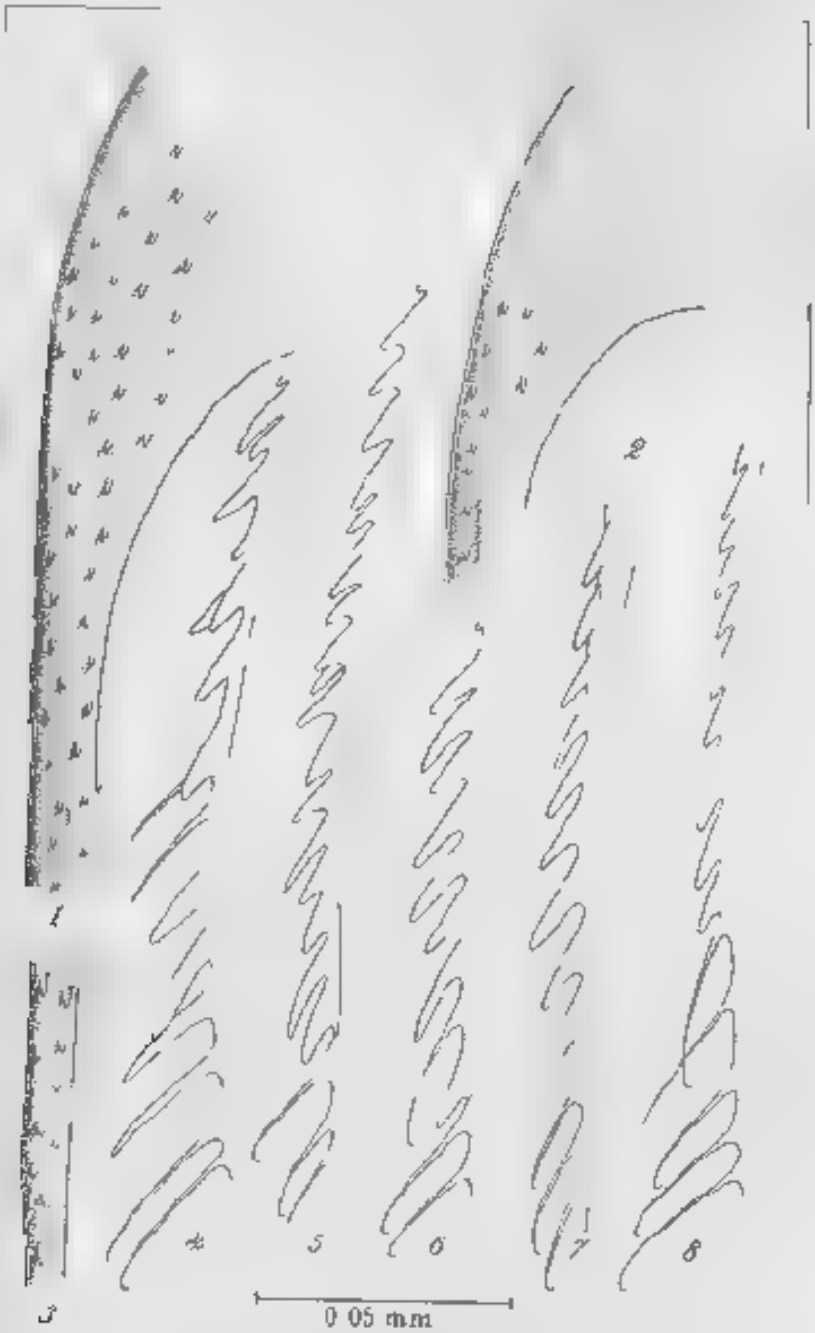


PLATE 25. DENTICLES AND ACCESSORY DENTICLES OF PADDLE GROUP PSEUDOMYLOMYA.

FURTHER OBSERVATIONS ON THE LIFE CYCLE OF GNATHOSTOMA SPINIGERUM[1]

By CARMEN D. ARMEÑA, PEDRO G. REFUERZO, and EUSEBIO T. GARCIA

Of the School of Hygiene and Public Health, University of the Philippines, Manila

In a recent study we (Armeña, Refuerzo and Garcia, 1936) reported the occurrence of encysted gnathostome larvae (presumably of *G. spinigerum*) in the muscles of three species of fresh-water fishes (*Glossogobius giuris*, *Ophiocephalus striatus* and *Therapon argenteus*), which when fed to white rats have been found to undergo development both in size and structure in the liver and skeletal muscles of these animals. We, therefore, advanced the tentative view that suitable and susceptible hosts possibly get *Gnathostoma* infestations not by drinking water containing infected cyclopes as suggested by Fromman and Daengsvang (1933) following their success in infecting this crustacean with larvae from hatched eggs of *G. spinigerum*, but by eating raw fresh-water fish containing encysted gnathostome larvae. While we were putting our view to further experimental tests on cats this time, Fromman and Daengsvang (1936) reported their successful experimental infection of *Clarias batrachus* (a fresh-water fish) with encysted gnathostome larvae by feeding it with experimental infected cyclopes. We are reporting here the results of our feeding of a cat with encysted gnathostome larvae from naturally infested fish and our feeding an uninfected aquatic snake.

EXPERIMENT

Through the kindness of Dr. Marcos Tubangui, chief of the biological division of the Bureau of Science, Manila, we were able to obtain two adult cats which were reared from the litter under conditions that seem to preclude any possibility of their having contracted gnathostome infestation insofar as water and food or caging conditions were concerned. The two cats had

[1] Aided by a special research grant from the Board of Regents, University of the Philippines. Submitted for publication July 20, 1936.

never been given fish as part of their diet and they had, as far as we are aware, absolutely no access to fish accidentally or otherwise. One of the two cats was given per orem 4, 7, and 5 encysted gnathostome larvæ obtained from the flesh of *Glossogobius giuris* January 22, January 25, and February 14, 1936, respectively. The other cat was used as control. The two cats were placed in separate metal cages with screened floor far from other animals, and extreme precautions were taken to avoid giving them food or water other than those prescribed during the course of the experiment. Both cats were negative for helminth eggs at the start of our work.

About one and one-half months after the first feeding the droppings from the two cats were examined for gnathostome eggs from time to time, but both cats were consistently negative throughout the experiment. As we were getting impatient waiting for the appearance of the eggs and curious about the result of our feeding, we decided to sacrifice the experimental cat May 18, 1936, exactly 3 months 26 days after the first infection. On opening the stomach two nodules were found in the fundus, the larger one, which apparently had established a communication with the gastric lumen, contained two apparently mature gnathostomes (male and female), and the smaller nodule, which did not show any communication at all with the gastric cavity, contained one semimature worm. Two semimature worms were also found in the diaphragm. The intestines and other internal organs were free from infestation. The fæcal contents of the large intestine did not show the presence of eggs after repeated microscopic examination of concentrated samples.

The following are the measurements of the male and female worms recovered from the larger stomach nodule of our infested cat:

		Male	Female
Length	mm	21	24
Diameter	mm	0.612	0.75
Globular cephalic swelling	mm	0.5 × 0.320	0.50 × 0.256
Œsophagus	mm	2.3 × 0.525	0.30 × 0.625
Intestine, length	mm	7.6	8.60
Transverse rows of cephalic hooklets		8	
Size of hooklets	mm	0.018 × 0.010	0.0 8 × 0.016

The anterior body spines are broad and have three sharp terminal points, the posterior body spines are narrow and have only one point. The number of rows of cephalic hooklets in the semimature worms obtained from the smaller stomach nodule and diaphragm varies from eight to nine.

The control cat was sacrificed May 25, 1936, and was found negative after an extensive search for evidence of infestation in the stomach, intestine, liver, muscles, and other internal organs.

GNATHOSTOME LARVÆ IN SNAKES

An opportunity to study gnathostome larvæ in reptiles was presented when six aquatic snakes, *Herpeton rhynchops* (Schneider), were brought to our laboratory from Bulacan, a province near Manila. Dissection of these snakes revealed a large number of gnathostome larvæ (presumably of *G. spinigerum*), encysted in the mesentery and muscles immediately surrounding the parietal peritoneum. Some apparently semimature forms were also embedded just underneath the skin. The encysted larvæ have four transverse rows of cephalic hooklets and in size and structure resemble the ones found by us in the flesh of fresh-water fishes. The semimature ones found under the skin have from four to five transverse rows of cephalic hooklets and are considerably larger than the encysted ones. Because of the lack of available laboratory animals at the time the snakes were brought to us no feeding experiment was made, which we greatly deplore.

REMARKS

The two mature (male and female) worms obtained from a typical stomach nodule of our experimentally infested cat and the three semimature worms, one of which was also found in the stomach and the other two in the diaphragm, presumably resulted from our feeding of this animal with encysted larvæ of *Gnathostoma* from the flesh of *Glossogobius giuris* (a fresh-water fish), which together with *Ophiocephalus striatus* and *Therapon argenteus* (also fresh-water fishes) had previously been found naturally infested with these larvæ. The difficulty of finding cats that are absolutely free from infestation did not permit us to use a larger number of cats in this experiment, but we were satisfied by the assurance of Doctor Tubangui that

the two cats he gave as could be considered "clean" insofar as gnathostome infestation was concerned.

Morphologically the adult worms obtained from one of the stomach nodules answer faithfully the description of *G. spinigerum* even to the details of the body spines as given by Faust (1929). The number of transverse rows of cephalic hooklets is 8 in the male and 11 in the female, a fact which confirmed the findings of Hayes and Lane (1920) that the number of transverse rows of cephalic hooklets in *Gnathostoma spinigerum* varies from 8 to 11. The five adult gnathostomes that we recovered from stomach nodules of naturally infested cats during our previous study of this subject also had 9 transverse rows of cephalic hooklets.

The absence of eggs in the feces of our experimentally infested cat may merely indicate that oviposition had not yet commenced at the time our animal was sacrificed. Perhaps we could have recovered eggs in the feces of this animal had we delayed our autopsy for a few weeks.

The consistent failure of Promnas and Daengsvang (1933 and 1936) to infect cats with cyclopes containing *G. spinigerum* larvæ from 7 to 30 days old, and their (1936) success in infecting a fresh-water fish (*Clarias batrachus*) with encysted larvæ by feeding it with experimentally infested cyclopes, our accidental finding of encysted gnathostome larvæ in the flesh of these species of fresh-water fishes under natural conditions, and finally, our successful infestation of a presumably "clean" cat with adult gnathostomes occurring in a typical stomach nodule by feeding this animal with encysted larvæ from naturally infested *Glossogobius giuris*, all seem to point definitely to the fact that gnathostomes require in their life cycle a second intermediate host in the form of a fresh-water fish.

Our finding of gnathostome larvæ apparently of two distinct groups with regard to size and degree of development in *Hierophis rhynchops* (Schneider) has developed a peculiar situation insofar as snakes are concerned in the life cycle of *G. spinigerum*. In our first paper on this subject (Africa, Refuerzo, and Garcia, 1936) we remarked that the fact that the larvæ which Chandler (1935) recovered from snakes approximate both in size and structure the encysted larvæ from the flesh of fishes would imply that the snakes act in the same capacity as the fishes which even at that time we were ready inclined to be the second intermediate host of *G. spinigerum*. On the other hand, we mentioned the possibility of the snakes assuming the

role of the sexually insultable host of this nematode, that is one that would allow the development of the worm only up to a certain stage short of maturity and not become a second intermediate host.

SUMMARY

A cat, presumably free from previous infestation of *G. spinigerum*, has been successfully infested with this gnathostome by feeding it with the encysted larvae from a naturally infested *G. spinigerum* (a fresh-water fish). This result tends to confirm the view we advanced in a previous work (Africa, Refuerzo, and Garcia 1936) that suitable and insuitable hosts of *G. spinigerum* possibly get their infestation not by drinking water containing infected cyclopes but by eating infested fresh-water fishes which in turn have eaten infected cyclopes.

Our finding of two apparently different groups of gnathostome larvæ in *Herpe rhynchops* (Schneider), an aquatic snake, indicates that the possible rôle of snakes in the life cycle of *G. spinigerum* needs further study.

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SOMATIC HETEROPHYIDIASIS IN FISH-EATING BIRDS, II

PRESENCE OF ADULTS AND EGGS IN THE BILE DUCTS OF THE CATTLE EGRET [1]

By CANDIDO M AFRICA, WALFRIDO DE LEON, and EUSEBIO Y GARCIA

Of the School of Hygiene and Public Health, University of the Philippines, Manila

TWO PLATES

As we were curious to know if *Monorchotrema taihokui* and *M taichui* show the same proclivity to invade the internal organs in their bird host as they do in man (1, 2, 3, 4) and encouraged by our success in finding what appears to be an extension of *Stictodora* infestation from the small intestine to the pancreas in a sea gull (*Larus ridibundus* Linn.) (5) we examined a large number of cattle egrets (*Bubulcus ibis coromandus* Boddaert), which we previously found to harbor both these heterophyids in the small intestine, and discovered large concentrations of eggs (presumably of these flukes) as well as adult parasites in the bile ducts of three of the twenty-seven birds dissected. Fifteen of the egrets showed the presence of one or both of these heterophyids in the small intestines, an incidence of 55.4 per cent. No evidence of extension of the infestation was found in the following organs: Pancreas, spleen, heart, kidneys, and lungs. This report deals chiefly with our findings in the liver of this bird.

TECHNIC AND MATERIALS

The twenty-seven egrets examined in this work were bought from a dealer who caught them at different points along the shore of Laguna de Bay, a fresh water lake about 25 kilometers south of Manila, Luzon. The technic we followed in this investigation is more or less similar to the one we adopted in our investigation on human heterophyidiasis (4) and hence will not be redescribed here. After determining the presence of

Aided by a special research grant from the Board of Regents, University of the Philippines.

either one or both of these heterophyids in the small intestine of this bird, the liver, pancreas, kidneys, heart, lungs, and spleen were mounted, removed, and preserved. Multiple blocks were cut from each of the above-mentioned organs for serial sectioning. It is felt that each of the organs mentioned above has been sufficiently covered or explored in each bird for the purpose of this work.

DESCRIPTION OF THE LESIONS

In this paper we are limiting ourselves to the consideration of the liver since no evidence of the extension of the infestation to the other organs has been found.

Grossly the infested liver does not show any abnormality that would differentiate it from the uninfected one. Except in portal areas that happen to contain collections of heterophyid eggs or, occasionally, what appear to be adult flukes or remnants of them, even the examination of histological sections has failed to reveal any marked abnormality other than evidence of mild degenerative changes due to pressure observed here and there in the parenchymatous areas. Actual hemorrhage or any recent or remote indication of it is conspicuously lacking. The parasites are confined within the portal area, invariably in the immediate vicinity of the portal vessels, no evidence of their presence is found in other areas. This finding suggests that the flukes probably arrived in the liver from the intestine by way of the bile passages. Whenever the fluke or flukes show long residence in the locality as indicated by the complete disappearance of any remnants of them except their eggs a definite chronic inflammatory reaction in the form of a fibrotic capsule with leucocytic infiltration, mostly of the round-cell variety, is observed around the parasites. Eosinophiles are conspicuously absent. Scattered here and there along this fibrotic wall, mostly on the outside, are islets of bile epithelium, indicating attempts at regeneration of the destroyed bile ducts. Within the fibrotic capsule and in direct contact with the egg collection are numerous endothelial cells, some of which have fused to form giant cells. The flukes that have just arrived in the bile ducts as indicated by beautifully stained reproductive glands and well-stained miracidia within their eggs, are not surrounded by any marked cellular reaction except that the bile duct containing the parasite is greatly dilated, the epithelium is obliterated and there is a very scanty fibrotic formation which is devoid of any leucocytic infiltration. The sheets or masses of

cells of the type we found in vascular lesions primarily caused by heterophyid eggs in human cardiac and cerebral heterophyidiasis (2, 3, 4) as well as in heterophyid infestation in the pancreas of a sea gull (*Larus ridibundus*), 5) have not been observed in any of the sections in the present material.

DISCUSSION

The evidence we have gathered in this paper tends to show that *Monorchotrema taiwana* and *M. fraterna* do not behave in the bird as they do in their human host. The tendency to invade the general circulation and consequently internal organs quite remote from their intestinal habitat which we have observed recently in human infestations with these flukes, (1, 2, 3, 4) appears to be absent in their avian host. At least insofar as the cattle egret is concerned, the farthest organ from the intestine they have reached is the liver which they seem to invade not through the agency of the blood circulation but through the bile passages. That this tendency to invade the bile ducts seems to be rather unusual in the avian host is indicated by the fact that of fifteen birds positive for either *M. taiwana* or *M. faitoketsi*, or both, only three showed flukes or evidence of their presence in the liver.

This finding raises the question as to whether the cattle egret is the normal host of these heterophyids. The term normal host (used here advisedly) implies an animal which allows a parasite to run a normal course of parasitic existence conducive to its proper propagation and well-being and which on the other hand suffers a minimum of damage in doing so. This necessarily involves a state of adaptation between the host and the parasite which is gradually developed in proportion to the length of time of their parasitic association, the tendency being to arrive at a condition of perfect adjustment between parasite and host. That the adjustment between these *Monorchotrema* spp. and their human host is not as good as that which they enjoy in their avian host would appear from the fact that we frequently found the eggs of these heterophyids in the feces of infected birds without the use of any special technic other than ordinary fecal-smear examination, a thing which we were not able to do in human heterophyid infestation even in cases where adult flukes were recovered in the intestinal scrapings.

The parasitic relationship between these heterophyids and their avian host appears to be more balanced and therefore more conducive to a normal parasitic existence. In other words

a parasitic relationship wherein a condition of "live and let live" is attained appears to have been developed after long and continuous contact between *M. taihokui* and *M. fuscata* on the one hand and the snail host against which the former [illegible] on the other. From heterophyid eggs do not seem to have the tendency to [illegible] the snail host and [illegible] some of them may wander in the bile passages of the liver. Such migration does not seem to be a usual or normal occurrence, as has been pointed out above. Those flukes that happen to be in the wrong place seem to produce little or no damage to endanger the life of the host. For this reason we feel inclined to hold the view that the snail serves the first [illegible] development of these heterophyid flukes as one of the [illegible] hosts whose droppings pollute the water where the appropriate snail host may be found. This view is supported by our finding of the metacercaria of *M. taihokui* in two species of fresh-water fishes (*Arius manillensis* "kanduli," and *Clarias batrachus*, "hito") in Laguna de Bay along the shore of which this bird abounds. [illegible] may be of interest to note that a human infestation with *M. tenuicollis* with myocardial complication has been reported by Africa de Leon, and Garcia[6] from Bohol, a town on the shore of the above-mentioned lake.

On the other hand, as a result of an unbalanced parasitic [illegible] seems to exist between these heterophyids and their human host, these flukes, as shown in our previous publications, seem to have the tendency to penetrate far into the deeper layers of the wall of the small intestine after maturement and there to die, disintegrate, and give up their eggs, which are later absorbed by the blood stream and lymphatics to [illegible] parts of the body. In such cases these flukes not only tend to shorten the life of their human host, but also lose their opportunity to expel their eggs through natural and proper channels. This fact perhaps explains the apparent absence of their eggs in the feces of infected persons. Such a condition is far from being conducive to successful parasitism, which consists chiefly in the ability of the parasite to do the least damage possible to their host and at the same time give reproduce, and provide natural exit for their young in order to reach new hosts for the perpetuation of their kind.

The present finding in the cattle egret is quite analogous to what we have observed in a sea gull (*Larus ridibundus*), in the [illegible] of which we found numerous large collections of eggs, presumably of *Stictodora* spp. which occurred in large

numbers in the small intestine of this bird. The small number of birds examined in this work does not warrant the assumption that these species of heterophyids confine their migration to the pancreas in this bird, for further dissection may reveal their presence in other organs also, especially the liver. Evidence gathered so far seems to show that in *Stictodora* infestation the invasion of the pancreas is by way of the pancreatic duct, even as the invasion of the liver in the *Monorchotrema* spp. infestation is through the bile duct. In the event that these two groups of heterophyids are finally proven to have a specific affinity for the respective organs mentioned above, an inexplicable phenomenon analogous to the specific affinity of the three human schistosomes for the different tributaries of the portal vein, will be established since the bile duct and the pancreatic duct have a common stem from the intestinal lumen.

SUMMARY

Of twenty-seven cattle egrets (*Bubulcus ibis coromandus* Boddaert) examined fifteen showed the presence of either *Monorchotrema taiholae* or *M. taichui*, or both, in the small intestine, and three of the infested birds showed extension of the infestation to the bile ducts of the liver, but none in other internal organs. The flukes appear to have invaded the liver through the bile ducts, there being neither evidence of vascular disturbances in the infested organ nor signs of the presence of flukes or their remnants in areas other than the immediate vicinity of the portal vessels. The lesions found consist of chronic inflammatory reaction in the form of fibrotic capsules with leucocytic infiltrations, mostly of the round-cell variety, surrounding the parasites, and hyperplastic changes of the bile ducts. The hostal relations of *M. taiholae* and *M. taichui* with their human and avian hosts are discussed and the possibility of the cattle egret acting as a reservoir host of these heterophyids is suggested.

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ILLUSTRATIONS

Plate 1

Fig. 1. Photomicrograph (low power) of a section of the liver of a cattle egret (*Bubulcus ibis coromandus* Boddaert) showing transverse sections of two flukes in a greatly dilated bile duct. Note the scanty fibrotic capsule around the parasites.

2. Photomicrograph (low power) of another section of the same liver showing a collection of eggs surrounded by a thick fibrotic capsule with leucocytic infiltration mostly of the round-cell variety. Note (*a*) hyperplastic bile ducts, (*b*) giant cells, (*c*) portal vein.

Plate 2

Fig. 1. The same section as in Plate 1, fig. 1, under high magnification.

2. The same section as in Plate 1, fig. 2, under high magnification showing the character of the fibrotic capsule surrounding the empty eggs and the giant cells trying to engulf the eggs at the periphery of the collection.

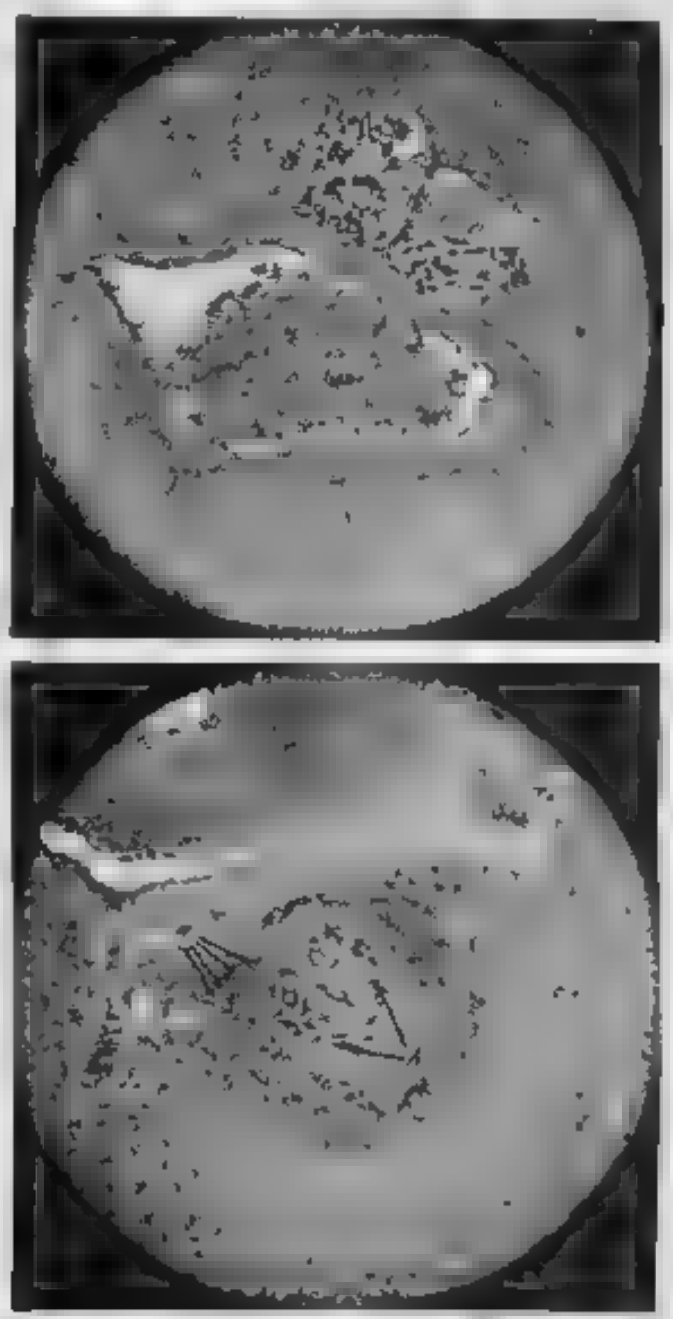


PLATE 1

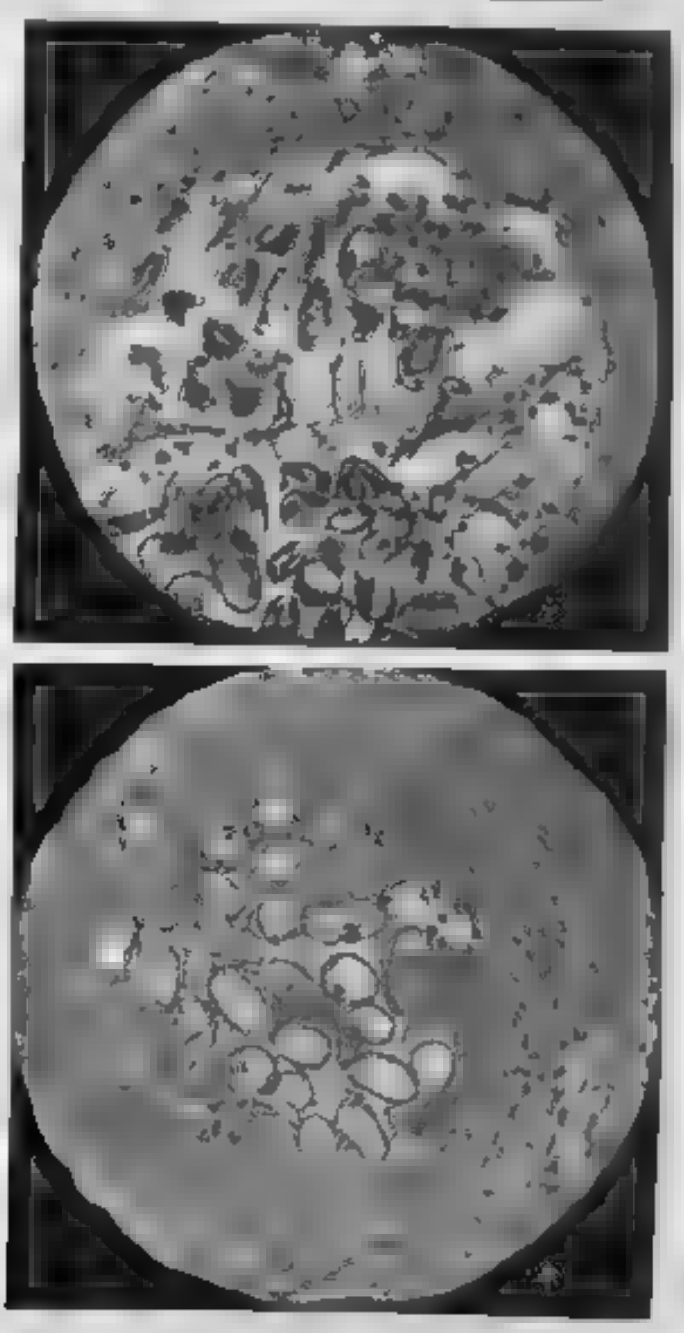


PLATE 2

BORNEAN MOSSES, PRINCIPALLY FROM MOUNT KINABALU

By EDWIN B. BARTRAM

Of Bushkill, Pike County, Pennsylvania

ONE PLATE

During the latter part of 1933 Mr. and Mrs. Joseph Clemens actively collected mosses in the Kinabalu region, Borneo, at altitudes between 3,500 and 12,500 feet. The details of this collection can now be recorded without fear of duplicating any of the new species included in Dixon's important paper.[1]

The presence of five new species and three new varieties in addition to eighteen species not previously known from Borneo emphasizes again the almost inexhaustible riches of this tropical flora.

An especially interesting isolated group from the higher elevations of Kinabalu up to 12,500 feet includes *Andreaea petrophila* var. *rubicunda*, *Grimmia ovata* and *Rhacomitrium crispulum*, all of them new to Borneo and showing a wide break in geographic distribution. Further explorations of this high granite dome will probably reveal more species of the affinities.

Included in the list are a few collections by E. Mjoberg from Mount Tibang, located near the junction of the Kapuas and Iran Mountain Ranges in the upper center of the island, which came from the Farlow herbarium.

Unless otherwise indicated the collections listed below are by J. and M. S. Clemens from Mount Kinabalu.

ANDREAEACEÆ

ANDREAEA PETROPHILA Ehrh. var. RUBICUNDA var. nov.

Folia conferta, sicca suberecta, saepe rotundato-obtusa, intense rubra.

BORNEO. Gurulau Spur, base of Victoria Peak, on granite slope, elevation 12,500 feet, *Clemens s. n.*

A significant range extension of this species as broadly interpreted, and a suggestive addition to the Bornean flora indicating a closer bond with the Himalaya region than with any other.

FISSIDENTACEÆ

FISSIDENS ASPLENIOIDES Hedw

On rock near Dehobang Falls, Penataban, elevation 5,000 feet, *Clemens 9290d.*

New to Borneo. The nearest records for this species are from Java and Sumatra.

DITRICHACEÆ

DITRICHUM FLEXIFOLIUM (Hook.) Hpe.

Gurulau Spur, elevation 10,000 feet, on rocks, north of Paka, Kadamian River, head of low ridge of Gurulau Spur, base of Victoria Peak, elevation 12,500 feet, on granite slope.

DICRANACEÆ

DICRANELLA SETIFERA Mitt. Jaeg.

Tenompok, yellow soil in damp exposed place, elevation 5,000 feet.

CAMPYLOPUS (EUTRICHELLA) C. M. Jaeg.

Pinokkok Falls, elevation 6,000 feet, on wet rocks. Penataban, on wet rocks near Pinokkok Falls, elevation 6,500 feet, *Clemens 9975a.*

New to Borneo. Previously known only from the Philippines.

CAMPYLOPUS (MICROLATUS) (C. M.) Arn. & Bartr.

Masilan River, elevation 6,000 feet, *Clemens 51178.* Gurulau Spur, elevation 8,000 feet, on rocks in stream bed, *Clemens 51211.* Gurulau Kamboranga, elevation 8,000 feet, Tenompok, damp rock, elevation 5,000 feet.

CAMPYLOPUS EXASPERATUS Brid.

Gurulau Spur, elevation 7,000 to 8,000 feet, *Clemens 51144.* South Gurulau Spur, elevation 7,000 to 8,000 feet, on trunks, logs, etc., *Clemens 51666.* Jungle trail below Gurulau Kamboranga, on trees, elevation 6,000 to 8,000 feet, *Clemens 51047a.* Masilan, near ford, elevation 7,000 feet, *Clemens 51654a.* Gurulau Spur near Gurulau Kamboranga, elevation 8,000 to 9,000 feet, *Clemens 50838b.* Penataban, near Pinokkok Falls, elevation 6,500 feet, *Clemens 10075.* Gurulau Spur, margin of recent landslide, North Paka and Kadamian River, elevation 10,500 feet, *Clemens 50535.*

DICRANODONTIUM NITIDUM Fleisch. var. **CLEMENSIAE** var. nov.

Cellulae basilares chlorophyllosae magis fortiter porosae.

Borneo, Mount Kinabalu, Gurulau Spur, elevation 7,000 to 8,000 feet, in dense masses on trees and trees, *Clemens 51029.*

type, *51438* Gurulau Spur, elevation 7,000 to 8,000 feet, mossy forest dripping *Clemens 51030* jungle trail below Gurulau Kamboranga, on trees, elevation 6,000 to 8,000 feet, *Clemens 51047b* Gurulau Spur jungle trail below Gurulau Lobang and Kamboranga, *Clemens 51047*

This seems to be a well-marked var ant and is possibly the form noted by Dixon[1] The leaves of the specimens noted here are however if anything wider than usual towards the base the area of clear rectangular cells is sharply defined from the very narrow marginal cells of the leaf base and grades abruptly into the chlorophyllose cells above which are very incrassate with strongly porose pellucid lateral walls

HOLOMITRIUM VACINATUM (Hook) Brid

Penibukan Ridge elevation 4,000 feet on forest tree, *Clemens 4643*

New to Borneo. Distributed over Java, Philippines, Pacific Islands.

DICRANOLOMA SUBECOSTATUM Dix

Dicranoloma subcostatum Broth.

Gurulau Spur, elevation 7,000 to 8,000 feet on trees and ground, *Clemens 51100, 51034, 51446*

DICRANOLOMA BREVISETUM (Hook and Wilk) Par

Penibukan, elevation 4,000 feet, ridge east of Dahobang River, on tree, *Clemens 50121*

DICRANOLOMA BRUNII (Hook) Par

Gurulau Spur, elevation 7,000 to 8,000 feet *Clemens 51431 51445a*

DICRANOLOMA ANG STIROSPERUM Dix

Tenompok elevation 5,000 feet on dead log, Columbon River basin, on tree bank above stream elevation 4,500 feet

DICRANOLOMA RUBRY-OMA Dix n sp BLUMEOLOPSIS VAR nov

Mount Tibang elevation 1,600 m. *Mjaberg* n Novembor 1925.

Very close to *D cuspidatum* and, in fact, inseparable except by the undulate leaves which give the plants a characteristic look The subula varies considerably in length and the hyaline border in width, but no more so than in typical plants that I owe to the kindness of Mr Dixon The leaf cells are quite

[1] Op. cit. 72

thin and poorly defined. The walls are relatively wide but of the same color as the lumens and hence quite indistinct

LEUCOLOMA MOLLE (C. M.) Mitt.

Jungle ridge near Dahobang River, elevation 3,500 feet, *Clemens 40594d*, Penibukan, ridge below camp, on branch, elevation 3,500 feet, *Clemens 50053c*.

BRAUNFELSIA SCABIOSA Wils. Par.

Maeiran River elevation 6,000 feet, *Clemens 51380a*. *51486* Gurulau Spur, elevation 7,000 to 8,000 feet, *Clemens 51440* Penibukan, near Pinokkok Falls, on rocks, wet jungle, elevation 6,000 feet, *Clemens 40934b*

BRAUNFELSIA PLICATA Lic. Fleisch.

Penibukan, near Pinokkok Falls, on rocks, wet jungle, elevation 6,000 feet, *Clemens 40934a*.

LEUCOBRYACEÆ

LEUCOBRYUM SANCTUM Hpe.

Mount Tabang, elevation 1,400 m. *Mjoberg s. n.*, November, 1925

LEUCOBRYUM TEYSMANNIANUM Doz. and Molk.

Penibukan, on log in jungle, elevation 4,500 feet, *Clemens 40713b*.

LEUCOBRYUM JAVANENSE Brid. Mitt.

Penibukan Ridge, on log, elevation 3,600 feet. *Clemens 40945c*

LEUCOBRYUM PULCHRUM Broch

Gurulau Spur, elevation 7,000 to 8,000 feet, mossy forest, on earth, *Clemens 51031*

LADOPODANTHUS PALLIDUS Doz. and Molk.

Jungle ridge above camp, on tree, elevation 4,500 feet, *Clemens 50305b* Penibukan elevation 4,000 feet, on twigs of tree. *Clemens 40531a*

These specimens are meager just a few plants in each case segregated from other mosses, but enough for identification.

New to Borneo. Distribution Java

LADOPODANTHUS SPECIOSUS Doz. and Molk. Fleisch.

Penibukan, elevation 6,000 feet, near Pinokkok Falls, on rocks, wet jungle, *Clemens 50438c*. Penibukan, elevation 5,000 feet, west ridge, jungle, *Clemens 50280*

EXODICTYON BLUMII (C. M. Fleisch.

Penibukan, elevation 4,000 feet, between flanges of 250-foot tree *Clemens 40658a*

LEUCOPHANES CANDIDUM (Hornsch.) Lindb.

Penibukan, jungle ridge near Dahobang River, elevation 3,600 feet, *Clemens 40594c*

CALYMPERACEÆ

SYRRHOPODON TRISTICHUS Nees

Penibukan, wall by side of Pinokkok Falls, elevation 6,500 feet, *Clemens 40899a*

SYRRHOPODON GARDNERI (Hook.) Schwaegr.

Jungle Spur, on bark of great tree, elevation 5,000 feet, *Clemens 50477a*

THYRIDIUM JUNGQUILIAN Mitt. ? sag.

Penibukan, ridge below camp elevation 3,500 to 4,000 feet, *Clemens 40431b, 50058b*

POTTIACEÆ

WEISIA CONTROVERSA Hedw.

Damp places elevation 3,500 feet.

New to Borneo. Distribution Cosmopolitan

BARBULA JAVANICA Dozy and Molk.

Penibukan on rocks near Dahobang Falls, elevation 5,000 feet, *Clemens 40290b*

New to Borneo. Distribution Himalayas, Java, Sumatra, Celebes, Philippines

GRIMMIACEÆ

GRIMMIA OVALIS (Hedw.) Lindb.

Gurdiau Spur base of Victoria Peak, elevation 12,500 feet, on granite slope. *Clemens 51511b.*

New to Borneo. Distribution wide in temperate regions and at high altitudes in the Tropics, but not recorded from Malaysia as far as I know.

RHACOMITRIUM CRISPULUM (H. f. and W.) H. f. and W.

Gurdiau Spur base of Victoria Peak, elevation 12,500 feet on granite slope *Clemens 51511*

New to Borneo. Distribution Fuegia New Zealand

These plants seem to represent one of the forms of this protean species with the leaves merely acute and lacking any

trace of a hair point. It is a wide extension in the geographic range of the species, but I can find no character of any importance by which it might be separated.

RHACOMITRIUM JAVANICUM Bryol. Jav.

Masilan River, on stones, forest, elevation 5,000 to 7,000 feet (unexplored region), *Clemens 51664*.

FUNARIACEÆ

FUNARIA CALVESCENS Schwaegr.

Masilan River, elevation 7,000 to 9,000 feet near Iobang, *Clemens 51282*.

BRYACEÆ

BRACHYMENIUM NEPALENSE Hook.

Gurulau Spur, jungle spur, on great tree near camp, elevation 5,000 feet, *Clemens 50479*. Masilan River, elevation 6,000 feet, *Clemens 51330*. Pinokkok Falls, on rock.

BRYUM NITENS Hook.

Penibukan, on rock near Dahobang Falls, elevation 5,000 feet, *Clemens 50290f*.

New to Borneo. Distribution: Nepal, Ceylon, Java.

RHODOBRYUM GIGANTEUM (Hook.) Par.

Head of Columbon River, elevation 5,000 to 7,000 feet, mossy forest.

MNIACEÆ

MNIUM ROSTRATUM Schrad.

Head of Columbon River, mossy forest. Keebamban River, elevation 5,000 to 6,000 feet, Masilan River near Iobang, elevation 6,000 feet, *Clemens 51288a*.

RHIZOGONIACEÆ

RHIZOGONIUM SPINIFORME (Hedw.) Bruch.

Numerous collections from 3,500 to 6,500 feet elevation.

HYPNODENDRACEÆ

HYPNODENDRON BECCARII Bpe. & Jaeg.

Penibukan, ridge, jungle log, elevation 4,500 feet, *Clemens 40857a*. Penibukan, ridge east of Dahobang River, elevation 4,000 feet, *Clemens 50075*. Columbon River basin, on tree, bank

above stream elevation 4,500 feet, *Clemens 3923* Tenompok, elevation 5,000 feet, on damp logs

These collections are richly fruited and show the characteristic orange coloration and the smooth capsules mentioned by Dixon

MNIOBRYUM QUADRICATUM Bernch. and Rehw. Lindb.

Penibukan, elevation 4,500 feet, on log, *Clemens 40567 40713* Penibukan Lubang 11 above Pinokkok, elevation 5,500 feet, *Clemens 50432*, Penibukan, elevation 6 000 feet, near Pinokkok Falls, on log *Clemens 50151*

MNIOBRYUM ARISTATULUM sp. nov.

Gurulau Kamborangs scrub forest, elevation 7 000 to 9,000 feet *Clemens 50787* Gurulau Spur, elevation 8.000 feet, south side of spur, mossy epiphytic thickets on rock, *Clemens 51177*, head of Pinokkok River elevation 8,000 feet, *Clemens 50871*

BARTRAMIACEÆ

PHILONOTIS LEIOCARPUS IMPERFECTA sp. nov

Dioica laxe caespitosa gracilis, sordide viridis Caulis parce hue radiculosus, apice in ramulos fasciculatum divisus. Folia erecto-patentia angustate lanceolata, breviter acuminata carinato-concava, 0.8 mm longa, ubique serrulata, marginibus erectis vel angustissime recurvis, costa valida percurrens, dorso fere ad basin scabra, cellulae superiores oblongae, 7 ad 8 μ latae et 10 ad 20 μ longae, apice papillosae, parietibus tenuibus, basilares subsimplices ad 25 μ longae Seta 16 ad 18 mm longa, tenuis theca subglobosa, erecta ad 1 5 mm longa peristomium imperfectum simplex, profunde insertum dentes aurantiaci, papillosi, brevissimi, spori 18 ad 24 μ

BORNEO, Mount Kinabalu, damp place, June 7, 1932, *Clemens s. n.*

This neat little plant is evidently closely allied through the rudimentary peristome to *P tyloderias* (Besch.), but appears to be perfectly distinct in the erect-spreading leaves shorter areolation, and especially by the shorter, broader leaf cells with the costa percurrent or even ending below the apex

PHILONOTIS SECUNDA (Dix. and Bolle.)

Tenompok damp soil elevation 5,000 feet. Penibukan, elevation 5,000 feet, on rock near Dahobang Falls *Clemens 40390*

New to Borneo Distribution: Sumatra, Java, Philippines

SPIRIDENTACEÆ

SPIRIDENS REINWARDTII Nees.

Colomban River basin elevation 7,500 feet, north wall below falls, *Clemens 33175*. Maxilan River, elevation 8,000 to 9,000 feet, forest in unexplored region, *Clemens 51965*.

ORTHOTRICHACEÆ

MACROMITRIUM PENDERIPOLIUM Dix.

Penibukan, elevation 4,000 feet on logs and trees near camp. *Clemens 40757*, *40436*.

MACROMITRIUM (GONIOTOMA) CLEMENSIAE sp. nov.

Robustiusculum, caespitosum, caespitibus fuscescentibus, opacis. Caulis elongatus, dense ramosus, ramis circa 2 cm longis, dense foliosis. Folia ramea sicca erecto-flexuosa, humida squarroso-recurvata, spiraliter serrata, carinato-concava e basi ovata sensim anguste acuminata, circa 2 mm longa, marginibus erectis, apicem versus argute dentatis, costa brevider excurrente, cellulae superiores rotundatae, 8 ad 10 μ, papillosae, parietibus haud incrassatis, inferiores juxta-costales magnae, ovoidae, tuberes otae infimae lineares, marginales anguste lineares, limbum latum 10 ad 12 seriatum formantes. Folia perichaetialia erecta, e basi lanceolata longe acuminata ad 3.5 mm longa, seta circa 8 mm longa rubra, ubique scabrata, theca ellipsoidea, ore contracto, angulato peristomium simplex 50 ad 60 μ altum, dentibus inter se concretis, papillosis, spori variabiles ad 35 μ papillosi.

Borneo, Mount Kinabalu, Penibukan, elevation 4,000 feet, jungle, east ridge, on twigs of tree, *Clemens 40532* type. Penibukan, elevation 4,500 feet, jungle ridge above camp, on tree *Clemens 50503a*. Maxilan River, elevation 7,000 feet, on *Vernonia*, *Magnolia*, etc., *Clemens 51187b*.

If the affinities of this species are with *M. orthostichum* Nees as seems probable, the differences are very marked. *M. Clemensiae* is a much coarser plant with finely acuminate leaves imbricated in spiral rows. The basal areolation is unique in having the coarsely tuberculate cells of the leaf base widely bordered on each side by a broad band of very narrow incrassate smooth cells extending about one-fourth of the way up the margins.

MACROMITRIUM LONGIFOLIUM C. M.

Pinokok Falls, wet rocks, elevation 6,500 feet, *Clemens 50009a*.

MACROMITRIUM BLUMII Nees.

Penibukan, jungle ridge above camp on tree trunk, elevation 4,500 feet. *Clemens 50606* Penibukan, Pinokkok Falls, Lobang, branches of tree, elevation 5,000 feet *Clemens 50938*

MACROMITRIUM MICACEUM Dozy and Molk. C. M.

Masilan River, elevation 5,000 feet, on tree over Levago River *Clemens 51484* Masilan River, elevation 7 000 feet, on *Vernonia, Magnolia*, etc *Clemens 51487*

MACROMITRIUM OCHRACEOIDES Dix

Gurulad Spur above rise of Dahobang on Myrtaceæ, elevation 12.500 feet, *Clemens 50998*

SCHLOTHEIMIA WALLISII C. M.

Schlotheimia splendida Bl. †

Masilan River, elevation 7 000 feet on *Vernonia Magnolia*, etc *Clemens 51481c*

SCHLOTHEIMIA RUBIGINOSA C. B. Wright.

Gurulad Spur, above rise of Dahobang, on Myrtaceæ, elevation 12,500 feet, *Clemens 50998a*

LEPTODONTIOPSIS ORIENTALIS Dix

Gurulad Spur elevation 12.000 to 13.000 feet, above Pinokkok River granite dome, on rocks, *Clemens 51197* Gurulad Spur, above rise of Dahobang, elevation 12,500 feet, *Clemens 50448b* Gurulad Spur, base of Victoria Peak, elevation 12.500 feet, on granite slope

No. *51197*, a particularly abundant and in fine fruit. It is more robust than indicated by the description of the type collection with setæ up to 2.5 to 3 cm long, but is undoubtedly the same plant

I willingly defer to Mr Dixon's judgement in placing this species in *Leptodontiopsis* It has close and natural affinities however, with *Zygodon*, and especially with *Z tetragonostomus* A Br, from which it is clearly separable by the dioecious inflorescence, more strongly toothed leaf margins, large spores up to 30 to 35 μ, and the costa papillose on the back These distinctions are of specific importance, but their value as generic indicators remains to be established

RHACOPILACEÆ

RHACOPILUM SPECTABILE Reinw. and Hornsch.

Penibukan, near Pinokkok Falls on log, elevation 6,000 feet, *Clemens 50131a*, headwaters of Columbon River on rocks, elevation 4,500 feet.

HEDWIGIACEÆ

RHACOCARPUS ALPINUS (C. M. Wright) Par.

Mas. on elevation 7,000 feet, near ford. *Clemens 9164.*

CRYPHAEACEÆ

CRYPHAEA BORNEENSIS sp. nov.

Caules secundarii elongati, flexuosi, circa 10 cm. longi, irregulariter pinnati; ramis patulis, obtusis. Folia caulina sicca laxe erecta, humida erecto-patentia, 2.6 mm. longa, ovato-obtusa, marginibus planis, apicem versus remote dentatis, costa valida, infra apicem soluta, cellulae superiores rotundato-hexagonae, laevissimae, 7 ad 8 μ latae, haud incrassatae, inferiores juxta-costales lineares, marginales seriebus paucis subquadratae. Folia ramea minora. Perichaetium crassum, foliis e basi late convoluta, sensim in subulam dentatam productis, theca immersa, turgide ellipsoidea, deoperculata circa 1 mm. longa, operculum breviter conico-rostratum, calyptra ubique scabra, peristomium duplex, ut videtur, exostomii dentes anguste lanceolati, papillosi, endostomii membrana hyalinam, imperfectum processus 0, spori minute papillosi, 25 μ.

BORNEO, Mount Tuaang, elevation 1,400 m. *Ayoberg & K.*, November 1925.

This genus has not been recorded from Borneo, or from Malaysia, as far as I know. The long flexuose stems and foliation are suggestive of *C. dilatata* H. f. and W. from New Zealand, but the leaves are sharply toothed above and the perichaetial leaves distinctly serrulate on the margins and along the edges of the rigid aristate point. The inner peristome is very rudimentary, and apparently consists of an imperfect, lightly papillose, hyaline membrane about 75 μ high and more or less adherent to the teeth.

PTEROBRYACEÆ

SYRRHYNCHOSTELLA LAXISSIMA (Mitt. and Dix.) sp. nov.

Laxissima, palide viridis, nitidula. Caules ad 12 cm. longi, laxissime pinnati; ramis circa 1 cm. longis, complanatis, apice saepe ramuli tenuissimi microphyti emittentes. Folia patentia, ad 1.5 mm. longa, ecostata, ovato-lanceolata, concava, longe et tenuiter acuminata, superne minute dentriculata, cellulae omnes angustissimae, longae, laevissimae, basilimae fuscescentes, dorsales numerosae, laxae, hyalinae, haud vesiculosae. Caetera ignota.

BORNEO. Mount Kinabalu, Marai au Spur, jungle spur west of camp, trailing on twigs, elevation 5 000 feet *Clemens 50358a*

A distinct species in the lax pinnately branched stems in contrast to the rigid, dendroid habit of most of the group. The slender, microphyllous branches occur frequently and in some of the plants are quite conspicuous

ENDOTRICHELLA ELEGANS (Dz. and Molk.) Fleisch.

Penibukan, elevation 3,500 feet, ridge below camp, on branch *Clemens 50053*

METEORIACEÆ

METEORIUM MIQUELIANUM (C. M.) Fleisch.

Maskan River, elevation 7 000 feet, *Clemens 51280a 51487a*

No *51487a* is a remarkably robust form with crowded short turgid, golden yellow branches up to 5 to 6 mm wide with leaves.

PAPILLARIA FUSCESCENS (Hook.) Jaeg.

Tenompok on dead log, elevation 5,000 feet

FLORIBUNDARIA FLORIBUNDA (Dz. and Molk.) Fleisch.

Maskan River, elevation 7,000 feet, *Clemens 51282, 51487c* Penibukan, ridge, wall by side of Pinokkok Falls elevation 6,500 feet, *Clemens 40899b*

FLORIBUNDARIA TERETIDIOIDES Fleisch.

Penibukan, near Pinokkok Falls, elevation 6,500 feet, *Clemens 40979a*

New to Borneo. Distribution Java, Philippines

AEROBRYOPSIS LONGISSIMA (Dz. and Molk.) Fleisch.

Mount Kinabalu, without further data.

AEROBRYIDIUM LONGICUSPIS Broth.

Tenompok, on dead log, elevation 5,000 feet

NECKERACEÆ

HOMALIODENDRON FLABELLATUM (Dicks.) Fleisch.

Tenompok elevation 5,000 feet, on dead log.

PINNATELLA MUCRONATA (Lac.) Fleisch.

Jungle ridge near Dahobang River, elevation 3,500 feet, *Clemens 40594a*.

HOOKERIACEÆ

ERIOPUS REMOTIFOLIUS C. M.

Tenompok, on dead log, elevation 5,000 feet.

CALLICOSTELLA PAPILLATA (Mont.) Jaeg.

Pembukan, on old dead log, elevation 3,000 feet. *Clemens 40581a*

CALLICOSTELLA PRABAKTIANA (C. M.) Jaeg.

Near Tuaran, elevation 500 to 700 feet, on rock in stream between paddies, *Clemens 51293*

ACROSCIOPTERIUM RHAPHIDOSTEGUM (C. M.)

Dahobang River, on rocks near jungle, elevation 3,500 feet, *Clemens 40490*

New to Borneo. Distribution: Java, Celebes.

THUIDIACEÆ

THUIDIUM TAMARISCELLUM (C. M.)

Masilan River, near Tojang, elevation 6,000 feet, *Clemens 51283*

New to Borneo. Distribution: Northern India, Tonkin, Java, Sumatra, Philippines.

THUIDIUM GLAUCINUM (Mitt.) M. A.

Tenompok, on dead log, elevation 5,000 feet.

THUIDIUM LACUNOIDES Broth.

Jungle ridge near Dahobang River, elevation 3,500 feet, *Clemens 40594b*

THUIDIUM CYMBIFOLIUM (Doz. and Molk.)

On rock near Dahobang Falls, elevation 4,500 feet. *Clemens 40289b*

BRACHYTHECIACEÆ

BRACHYTHECIUM PLUMOSUM (Hedw.)

Pemibukan, on rock near Dahobang Falls, elevation 4,500 feet. *Clemens 40289, 40290a*, Pemibukan, base of wall north of Pinokok Falls, on rocks, elevation 7,000 feet, *Clemens 40382*. Masilan River, elevation 6,000 feet, *Clemens 51380*.

ENTODONTACEÆ

ENTODON BANDUNGAE (C. M.) Jaeg.

Damp rocks.

New to Borneo. Distribution: Java, Sumatra, Celebes, Philippines, Formosa.

SEMATOPHYLLACEÆ

TRISMEGISTIA PANDURIFORMIS (C. E. Wright) Broth.

Tenompok, damp logs, elevation 5,000 feet, head of Columbon River, mossy forest, Kesiam an River, elevation 5,000 to 6,000 feet.

TRISMEGISTIA RIGIDA (Hornsch. and Reinw.) Broth.

Numerous collections at altitudes between 3,500 and 8,000 feet.

RHASTOPOMA UNCINIFOLIUM Broth. Card.

Numerous collections from trees, logs, and stones up to 9,000 feet.

RHAPHIDOSTICHUM PILIFERUM Broth. Broth.

Pinokkok Falls, elevation 6,500 feet, on wet rocks, *Clemens 7002*.

New to Borneo. Distribution: Philippines.

ACROPORIUM CONVOLUTUM Fleisch.

On stones and trees, mossy jungle below Gurulau Lobang, elevation 6,000 to 8,000 feet, *Clemens 51451a*.

ACROPORIUM TURGIDUM Doz. and Molk. Fleisch.

Gurulau Spur, near stream, on tree trunks. *Clemens 51099*.

ACROPORIUM MONOICUM Fleisch.

Tenompok, on log, elevation 5,000 feet.

ACROPORIUM DIMINUTUM (Brid.) Fleisch.

Mount Tibang, *E. Mjoberg s. n.* November 1925.

TRICHOSTELEUM BOSCHII (Doz. and Molk.) Jaeg.

Penibukan below Danobang Falls, elevation 4,500 feet, on twig *Clemens 40294a*. Penibukan, near Pinokkok Falls, elevation 6,000 feet *Clemens 40973a*.

TRICHOSTELEUM LEPTOCARPON (Schwaegr.) Fleisch.

Penibukan side ridge, jungle, elevation 4,500 feet, *Clemens 40718*.

TRICHOSTELEUM LEPTOCARPON var. ALTEPAPILLOSUM Dix.

Gurulau Spur, elevation 7,000 to 8,000 feet, *Clemens 51436*, on stones and trees, mossy jungle below Gurulau Lobang, elevation 6,000 to 8,000 feet, *Clemens 51451*.

TRICHOSTELEUM HAMATUM (Doz. and Molk.) Jaeg.

Columbon River basin, on tree, elevation 4,500 feet, Penibukan Ridge, on forest tree, elevation 4,000 feet, *Clemens 40431a*.

TAXITHELIUM LINDBERGII Besch. and Card.

Penibukan near Pinokkok Falls, elevation 6,500 feet, *Clemens 4,973*.

TAXITHELIUM MAGNUM Fleisch.

Numerous collections from Tenompok, Penibukan, and Carulau Spur, mostly on twigs and branches of trees.

These collections vary considerably in size but differ in no way that I can see from *T. magnum* as represented in my herbarium by a specimen from Java collected and determined by Fleischer. The leaves are slenderly acuminate, sharply serrate above, the papillæ, when visible, few and inconspicuous, and the setæ often up to 2 cm or more long. The epiphytic habit on twigs and leaves seems to be constant in this species.

TAXITHELIUM SUBMARGINATUM (Lac.) Broth.

Penibukan Ridge, elevation 4,000 feet, damp jungle, *Clemens 40,011*.

TAXITHELIUM MICROSTOMUM Dix.

Tenompok damp logs, elevation 5,000 feet. Columbor River basin, on trees, elevation 4,500 feet.

HYPNACEÆ

ECTROPOTHECIUM PLICATUM Broth. and Dix. sp. nov.

Dioicum, robustum, flavescens parum nitidum. Caules ad 10 cm longi, radiculosi, dense irregulariter pinnati, ramis inæqualibus ad 2 cm longis, haud complanatis. Folia rigida, patentia, leniter falcata, plicata, circa 1.8 mm longa, e basi concava ovata acuminata, apice serrata, costa bina, brevissculis, male definita cellulis angustissime, inferioribus latioribus, incrassatae, valde porosae, alares paucissime, hyalinae vel nullae. Folia perichætialia sensim longe acuminata argute denticulata, seta 3 ad 5 cm longa, theca magna, fusca, 2 ad 2.2 mm longa, pendula, e collo distincto oblongo-ellyptica, operculum conico-rostratum, calyptra glabra.

BORNEO, Mount Kinabalu, Gurulau Spur, head of Pinokkok River, elevation 8,000 feet, on twigs, *Clemens 50,872*.

This species is unusually well marked by the rigid, plicate leaves, especially when dry, and the long setæ. *Ectropothecium Dixonii* Fleisch. has the leaves slightly plicate but is a much softer plant with longer leaf points and a much smaller sporophyte.

ECTROPOTHECIUM INTORQUATUM (Dix. and Milde) Jaeg.

Tenompok damp logs, elevation 5,000 feet.

ECTROPOTHECIUM BUITENZORGII Bel. Jaeg.

Gurulau Spur, elevation 4,000 fee Tenompok ra , on stumps etc. *Clemens 51056* Penibukan, Lebang 11, above Pinokkok River, elevation 3,500 feet, *Clemens 50132*

ECTROPOTHECIUM MORETII (C. M.) Jaeg.

Tenompok, elevation 5,000 feet.

ECTROPOTHECIUM CYPERDIDES (Hook. Jaeg.

Masilan River, elevation 6,000 feet, *Clemens 51480a*, Penibukan jungle ridge near Dahobang River, elevation 3,500 feet *Clemens 40594c*

VESICULARIA RETICULATA Bor. and Molk. Broth.

Dahobang River elevation 3,500 feet on rocks near jungle *Clemens 40490*

New to Borneo. Distribution Ind a, Singapore, Java, Sumatra Celebes, Philippines

ISOPTERYGIUM MINUTIRAMEUM (C. M.) Jaeg.

Gurulau Spur jungle spur, on bark of large tree near camp. elevation 5,000 feet. *Clemens 50477*

ISOPTERYGIUM ALBESCENS (Schwaegr.) Jaeg.

Tenompok, elevation 5,000 feet, on logs.

CTENIDIADELPHUS SPINULOSUS Broth.) Fleisch.

Tenompok, elevation 5 000 feet, on logs.

HYLOCOMIACEÆ

MACROTHAMNIUM JAVENSE Fleisch.

Penibukan on rocks near Dahobang Falls, elevation 4,500 feet *Clemens 40289a*, Moran Paran above Kamouranga (open places) taken from *Blechnum fluviatile* Lowe, elevation 10,000 feet, *Clemens 33122 bis*

POLYTRICHACEÆ

RHACELOPUS PILIFER Dus. and Molk.

Penibukan, elevation 3 500 feet, on stones in stream, *Clemens 40512*

POGONATUM WALLISII (C. M.) Jaeg.

Masilan River, elevation 6,000 feet, *Clemens 51379.*

New to Borneo. Distribution Philippines.

POGONATUM JUNGHUHNIANUM Dus. and Molk. Lac.

Tenompok, damp places, elevation 5,000 feet, jungle trail below Gurulau Kamboranga. on trees, elevation 6,000 to 8,000 feet, *Clemens 51047*

PODOCARPUS MACROPHYLLOIDES Brongn.

Head of Columbon River, elevation 5,000 to 7,000 f[illegible] Garulau Spur elevation 7,000 to 8,500 feet on rocks [illegible] *Clemens 50887, 51026, 51210*

DAWSONIA ALTISSIMA Gmb

Head of Columbon River, elevation 5,000 to 7,0[illegible]

DAWSONIA BREVIFOLIA Gepp

Garulau Spur elevation 7,000 to 8,000 feet, [illegible] forest, wet, *Clemens 51032*, Garulau Spur, Garulau [illegible] elevation 7,000 to 9,000 feet, *Clemens 50780* [illegible] northwestern base of Victoria Peak, elevation 12,[illegible] bank, edge of rivulet, *Clemens 51507*

ILLUSTRATION

Drawings by the author

PLATE 1

FIG. 1 *Platyneuron imperfectum* Bartr., *a* plant, × 1½, *b* and *c* leaves, × 20, *d*, apex of leaf, × 60, *e* upper leaf cells and margin, × 460, *f* part of peristome from the inside, × 160, *g*, capsule, × 14.

2. *Macromitrium Clemensiae* Bartr., *a* plant, × 1½, *b* and *c*, leaves, × 20, *d*, one side of leaf base, × 160, *e*, capsule, × 20.

3. *Symphysodontella tarissina* Bartr. and Dix., *a* plant, × 1½, *b* and *c* leaves, × 20.

4. *Cryphaea borneensis* Bartr., *a*, plant, × 1½, *b*, stem leaf, × 20; *c*, branch leaf, × 20, *d*, upper leaf cells and margin, × 460, *e*, capsule, × 20.

5. *Setroporthodon falcatum* Bartr. and Dix., *a*, plant, × 1½, *b* and *c*, leaves, × 20, *d*, perichaetial leaf, × 20.

PLATE

DIATOMS FROM BIWA LAKE, HONSHU ISLAND, NIPPON

By B. W. Skvortzow

Dr. Harbin, Manchukuo

EIGHT PLATES

Several years ago Prof. Dr. Tamiji Kawamura, of Kyoto, sent me a tube of diatom clay from Biwa Lake, Nippon. Biwa Lake, one of the largest in Nippon, is north of Osaka, Honshu Island, at 35° 23' north latitude. Its altitude is 86.3 meters, its area 644.8 square kilometers, and its maximum depth 95 meters.

A careful examination of the diatom sample yielded more than two hundred forms of siliceous algæ. From systematic and geographic points of view the diatoms from Biwa Lake are of great interest. Some of these diatoms are essentially tropical, others are characteristic of alpine and Arctic regions. Among the species found in Biwa Lake, the following seem to inhabit warmer climates:

Melosira solida	*Neidium obliquestriatum*
Melosira americana	*Navicula Lambda*
Melosira undulata	*Navicula Psia.*
Amphipleura pellucida v. *recta.*	*Amphora delphinea* var. *minor*
Cymbella tumidula.	*Gomphonema Borggreni.*

The northern elements are widely represented in Biwa Lake by many large species of *Stauroneis*, *Navicula*, *Pinnularia*, *Gomphonema* and *Cymbella*. *Didymosphenia geminata*, a common diatom in the northern part of Asia and of Europe, was also found. It was peculiar to find in Biwa Lake some species of American origin. *Melosira solida*, known from Arizona, was very abundant. *Stephanodiscus carconensis*, reported from Klamath Lake, Oregon, was represented by thousands of specimens. A distinct species, *Melosira americana*, known from tropical America, was also common in Biwa Lake. About eighty different diatoms known from Kizaki Lake were recovered in Biwa Lake. So were also forms, of frequent occurrence in Kizaki Lake,

Kindly reported on by Dr. M. Lemmermann, of the Otsu Hydrobiological Station, Nippon.

were not found in the Kawamura gathering, which can scarcely be because my sample is not sufficiently large. Over seventy new species and varieties of algæ are described from Biwa Lake, and some are very distinct and peculiar.

From the ecological point of view the following diatoms from Biwa Lake are plankton species.

Melosira granulata and var.	*Attheya Zachariasi.*
Melosira solida	*Chaetoceras* sp.
Cyclotella comta and var.	*Asterionella gracillima.*
Stephanodiscus carconensis.	*Asterionella formosa*
Coscinodiscus lacustris var.	

The other diatoms belong to a bottom formation and include large forms, such as, *Melosira undulata Opephora Martæ*, *Synedra Ulna* and var. and various species of *Epithemia*, *Cocconeis*, *Achnanthes*, *Navicula*, *Pinnularia*, *Cymbella*, *Gomphonema*, and *Surirella*. The last genus was very richly represented in the lake.

All of the diatoms listed in this note are fresh water species, and only a few forms can be referred to brackish water species, they are *Nanodiscus orientalis* var., *Nitzschia tryblionella* V. *Levidensis* and *N. Closterium*. This note is illustrated with drawings by the author, and they may be useful in future investigations.

MELOSIRA VARIANS C. A. Ag.

Melosira varians C. A. Ag. FR. HUSTEDT, Bacillar. (1930) 85, fig. 41.

Frustule cylindric, ca. 0.08 mm broad. Rare. Reported from Aokiko and Kizaki Lakes.

MELOSIRA GRANULATA (Ehr.) Ralfs? var. MUZZANENSIS (Meister) Bethge? Plate 1, fig. 29.

Melosira granulata (Ehr.) Ralfs? var. *muzzanensis* (Meister) Bethge? FR. H. HUSTEDT, Kryptogam. Flora 7 Band, Kieselalgen (1927) 254, fig. 105.

Frustule cylindrical, 0.01 mm broad, 0.017 mm long. Striæ punctate, 13 in 0.01 mm, forming close longitudinal rows, 15 in 0.01 mm. Not common. Known from European lakes.

MELOSIRA GRANULATA (Ehr.) Ralfs var. ANGUSTISSIMA O. Müll. Plate 1, fig. 7.

Melosira granulata (Ehr.) Ralfs var. *angustissima* O. Müll., FR. HUSTEDT Kryptogam. Flora 7 Band. Kieselalgen (1927) 250, fig. 104*d*.

Frustule long, narrow, cylindrical, 0.027 mm long, 0.0034 broad. Puncta spiral. Uncommon in Biwa Lake. A pelagic species.

MELOSIRA SOLIDA Eulenstein Plate 1 figs. 3 to 6, 10, 11, and 24

Melosira solida Eulenstein. VAN HEURCK Synopsis (1880–1881) p. 86, figs. 36-39

Frustule cylindrical, coarse, with thick siliceous margins. Length, 0.012 to 0.01 mm., breadth, 0.007 to 0.0085. Lateral horns massive, 0.0035 mm. long. Striæ punctate, 12 in 0.01 mm., puncta 12 to 15 in 0.01 mm. Abundant in Biwa Lake. Known from Carson, Arizona, and from Europe.

MELOSIRA SOLIDA Eulenstein var. NIPPONICA var. nov. Plate 1 figs. 1, 2, and 23

Differs from the type in its puncta, disposed only in the middle part of the frustule. Opposite ends hyaline. Length, 0.025 mm., breadth, 0.006. Striæ 12 and puncta 12 in 0.01 mm. Common with the type species.

MELOSIRA AMERICANA Kütz. fo. NIPPONICA fo. nov. Plate 1 fig. 16

Differs from the type in the presence of dots in the marginal sections of the frustule. Length and breadth about 0.0076 mm. The type is reported from tropical America and from Aokiko and Kizaki Lakes.

MELOSIRA UNDULATA (Ehr.) Kütz.

Melosira undulata (Ehr.) Kütz., A. SCHMIDT Atlas Diatom. (1893) pl. 180, figs. 1, 14, 16–19, 21.

Frustule cylindrical, with thick margins. Length, 0.068 mm. Not common in Biwa Lake. Reported from the Tropics and as a fossil from Europe. Common in Aokiko and Kizaki Lakes.

MELOSIRA UNDULATA (Ehr.) Kütz. var. NORMANN Arnott

Stephanogonia undulata Ehr. Kütz. var. *Normanni* Arnott. VAN HEURCK Synopsis (1880–1881) pl. 90, fig. 7.

Differs from the type in the polygonal shape of the inner part of the valve. Diameter of the frustules, 0.03 to 0.038 mm. A tropical diatom. Reported from Kizaki Lake.

CYCLOTELLA COMTA Ehr. Kütz.

Cyclotella comta (Ehr.) Kütz. FR. HUSTEDT, Bacillar. (1930) 104, fig. 68.

Valve circular, 0.01 to 0.015 mm. in diameter. The marginal zone striated. Striæ 16 in 0.01 mm. Middle zone punctulate. Not common in Biwa Lake. Reported from Aokiko and Kizaki Lakes.

CYCLOTELLA COMTA Ehr. Kütz. var. OLIGACTIS Ehr. Grun. Plate 1, fig. 22

Cyclotella comta (Ehr.) Kütz. var. *oligactis* (Ehr.) Grun. VAN HEURCK Synopsis (1880–1885) pl. 98, figs. 18, 19.

Valve 0.01 to 0.012 mm in diameter. Striae 15 in 0.01 mm. The middle punctа coarse, arranged in radiate lines of unequal length. Rare, with the type. Known from Europe.

CYCLOTELLA GLOMERATA Bachmann fo. NIPPONICA Skvortzow. Plate 1, fig. 18.

Cyclotella glomerata Bachmann fo. *nipponica* Skvortzow, Diatom Kozai Lake (1936) pl. 1, fig. 12.

Valve very small, about 0.005 mm in diameter. Striae fine, 18 in 0.01 mm. Common in Kizaki Lake.

STEPHANODISCUS CARCONENSIS Grun. Plate 1, figs. 19 and 22; Plate 6, fig. 2 (anomalous).

Stephanodiscus carconensis Grun., A. Schmidt Atlas Diatom. (1901) pl. 228, figs. 9, 10.

Valve large, circular, with 24 to 36 radial marginal processes, 3 in 0.01 mm. Beads large, robust, radiately disposed, 15 to 18 in 0.01 mm. Diameter of the valves 0.025 to 0.045 mm. Abundant in Biwa Lake. Known from Klamath Lake, Oregon, and Shasta Country, California.

STEPHANODISCUS CARCONENSIS Grun. var. PUSILLA Grun. Plate 1, figs. 8, 9, 14, 16, and 18.

Stephanodiscus carconensis Grun. var. *pusilla* Grun., A. Schmidt Atlas Diatom. (1901), p. 228, figs. 14, 12.

Valve minute, circular, strongly marked with coarse beads, becoming smaller only near the margin. Processes 6 to 13, radiate. Central area covered with beads. Margin distinct. Diameter of the valves 0.006 to 0.017 mm. Beads 15 in 0.01 mm. Common with the type.

STEPHANODISCUS BIWENSIS sp. nov. Plate 1, figs. 17 and 23.

Valve circular, strongly marked with coarse beads, irregularly at the center of the valve. The valve is ornamented with a corona of large spines on one-third of the valve border. Diameter of the valve 0.035 to 0.04 mm. Length of the spines 0.006 to 0.01 mm. Not common. The form most nearly resembling this species is *Stephanodiscus elegans* T. Brun, a fossil in Yedo, Nippon.

OSCINODISCUS LACUSTRIS Grun. var. NIPPONICA var. nov. Plate 1, fig. 26; Plate 6, fig.

Valve circular, marked with longitudinal, radiate rows of punctа forming in the center a hyaline space or corona of few punctа. Diameter 0.05 to 0.06 mm. Punctа 10 in 0.01 mm. Not common in Biwa Lake. The type is known from fresh and brackish waters from large Eurasian lakes.

ATTHEYA ZACHARIASI Brun. Plate 5, fig. 15

Attheya Zachariasi Brun, Fr. Hustedt, Bacillar. (1930) 118, fig. 99c.

This species is abundant in Biwa Lake, but found only as broken valves and endocysts. Length of endocysts, 0.028 to 0.034 mm., breadth, 0.0068 to 0.0085. Reported from Aokiko Lake. A pelagic species.

CHAETOCEROS sp.

The broken valves and filaments of this diatom were common in the Biwa sample. They were poor for identification.

TABELLARIA FENESTRATA (Lyngb.) Kütz.

Tabellaria fenestrata Lyngb. Kütz., Fr. Hustedt, Bacillar. (1930) 122, fig. 99.

Valve linear, undulate in the middle part and at the ends. Length, 0.05 mm., breadth, 0.007. Common in fresh water. Uncommon in Biwa Lake. Reported from Kizaki Lake.

TABELLARIA FLOCCULOSA (Roth) Kütz.

Tabellaria flocculosa (Roth) Kütz., Fr. Hustedt, Bacillar. (1930) 123, fig. 101.

Valve small, undulate. Length, 0.025 mm., breadth, 0.007. Reported from Aokiko and Kizaki Lakes.

DIATOMA HIEMALE (Lyngb.) Heiberg var. MESODON Ehr. Grun.

Diatoma hiemale (Lyngb.) Heiberg var. *mesodon* Ehr. Grun. Fr. Hustedt, Bacillar. (1930) 129, fig. 116.

Valve, oblong-lanceolate. Length, 0.017 mm., breadth, 0.007. Common in streams. Rare in Biwa Lake. Reported from Aokiko and Kizaki Lakes.

MERIDION CIRCULARE Agardh var. CONSTRICTA (Ralfs) Van Heurck.

Meridion circulare Agardh var. *constricta* Ralfs, Van Heurck, Fr. Hustedt, Bacillar. (1930) 131, fig. 119.

Valve clavate and capitate. Length, 0.039 mm., breadth, 0.005. Rare. Reported from Kizaki Lake.

OPEPHORA MARTYI Herib.

Opephora Martyi Herib., Fr. Hustedt, Bacillar. (1930) 132, fig. 20.

Valve ovate, attenuate towards both ends. Length, 0.019 mm., breadth, 0.005. Striæ robust, 7 to 8 in 0.01 m.m. Common. Known from the bottoms of large lakes. Reported from Aokiko and Kizaki Lakes.

FRAGILARIA CAPUCINA Desm.

Fragilaria capucina Desm., Fr. Hustedt, Bacillar. (1930) 138, fig. 126.

Valve linear, almost parallel, with slightly attenuated and rounded ends. Length 0.022 mm., breadth 0.002. Striæ 18 in 0.01 mm. Common in fresh water. Known from Aokiko and Kizaki Lakes.

CERATONEIS ARCUS Kütz. var. HATTORIANA Meister.

Ceratoneis arcus Kütz. var. *Hattoriana* Meister, Beiträge zur Bacillariacrenflora Japans. 2 (1914) 226–227, pl. 8, figs. 1–3.

Valve linear-lanceolate, attenuate at the ends. Length, 0.034 mm., breadth, 0.005. Striæ 15 in 0.01 mm. Reported from Tokyo and Kizaki Lakes. Not common in Biwa Lake.

ASTERIONELLA GRACILLIMA (Hantzsch) Heiberg.

Asterionella gracillima (Hantzsch) Heiberg. Fr. Hustedt, Bacillar. (1930) 147–148, fig. 157.

Valve linear with equally undulate ends. Length, 0.08 to 0.09 mm., breadth, 0.0017. Known from Kizaki Lake. A pelagic species.

ASTERIONELLA FORMOSA Hassall.

Asterionella formosa Hassal. Fr. Hustedt, Bacillar. (1930) 147, fig. 156.

Valve linear, ends unequally undulate. Length, 0.075 mm., breadth, 0.0017. Known from Aokiko Lake. Not abundant in Biwa Lake.

SYNEDRA ULNA (Nitzsch) Ehr.

Synedra Ulna (Nitzsch) Ehr. Fr. Hustedt, Bacillar. (1930) 151, figs. 158–159.

Valve linear, parallel, with attenuate ends. Length, 0.16 to 0.2 mm., breadth, 0.005 to 0.006. Striæ 9 in 0.01 mm. Not common. Reported from Aokiko and Kizaki Lakes.

SYNEDRA ULNA Nitzsch Ehr. var. RAMESI Herib. and Peragallo) Hust. Plate 9, fig. 14.

Synedra Ulna (Nitzsch Ehr. var. *Ramesi* (Herib. and Peragallo Hust. Hustedt, Bacillar. (1930) 152, fig. 162.

Valves broad, short with abruptly acuminate ends. Length, 0.039 to 0.042 mm., breadth, 0.007 to 0.0085. Striæ 9 to 10 in 0.01 mm. Reported from Kizaki Lake.

SYNEDRA ULNA (Nitzsch.) Ehr. var. DANICA (Kütz.) Grun.

Synedra Ulna (Nitzsch.) Ehr. var. *danica* (Kütz.) Grun., Fr. Hustedt, Bacillar. (1930) 164, fig. 168.

Valve very long and narrow, regularly attenuate towards the ends. Ends capitate. Length, 0.217 mm., breadth, 0.0048 to 0.005. Striæ 9 in 0.01 mm. Reported from Kizaki Lake.

SYNEDRA ULNA (Nitzsch.) Ehr. var. OXYRHYNCHUS (Kütz.) Van Heurck fo. CONSTRICTA Hustedt. Plate 1, fig. 16.

Synedra Ulna (Nitzsch.) Ehr. var. *oxyrhynchus* (Kütz.) Van Heurck fo. *constricta* Hustedt, Bacillar. (1930) 162, fig. 161.

Valve linear, abruptly constricted in the middle. Ends acuminate. Length, 0.078 mm., breadth, 0.006. Striæ 9 in 0.01 mm. Not common.

SYNEDRA ULNA (Nitzsch.) Ehr. var. AMPHIRHYNCHUS (Ehr.) Grun.

Synedra Ulna (Nitzsch.) Ehr. var. *amphirhynchus* (Ehr.) Grun., Fr. Hustedt, Bacillar. (1930), 164, fig. 167.

Valve linear, attenuate and capitate. Length, 0.12 mm.; breadth, 0.0068. Striæ 7 in 0.01 mm. Common in Biwa Lake.

SYNEDRA NANA Meister.

Synedra nana Meister Fr. Hustedt, Bacillar. (1930), 168, fig. 183.

Valve very narrow-linear, gradually attenuate to the ends. Length, 0.044 mm., breadth, 0.002. Striæ fine. 24 in 0.01 mm. Reported from alpine lakes, Lago di Crocetto, Bernina, Davoser Lake, Europe.

SYNEDRA NANA Meister var. NIPPONICA Skvortzow. Plate 6, fig. 11.

Synedra nana Meister var. *nipponica* Skvortzow, Diatom. Kizaki Lake (1936) p. 10, fig. 22.

Smaller than the type. Ends capitate. Length, 0.027 mm., breadth, 0.0012. Striæ 20 in 0.01 mm. Differs from the specimens from Kizaki Lake in the narrower valves and the number of striæ. Not common.

SYNEDRA RUMPENS Kütz. var. MENEGHINIANA Grun.

Synedra rumpens Kütz. var. *Meneghiniana* Grun. Fr. Hustedt, Bacillar. (1930) 156, fig. 178.

Valve linear-lanceolate with slightly capitate ends. Length, 0.027 mm., breadth, 0.0034. Striæ 12 in 0.01 mm. Reported from Kizaki Lake.

SYNEDRA RUMPENS Kütz. var. FRAGILARIOIDES Grun. fo. NIPPONICA fo. nov. Plate 3, fig. 1.

Differs from the type in its finer striæ. In the middle part the valve is undulate. Length, 0.018 mm, breadth, 0.0034. Striæ 15 in 0.01 mm, not punctate. Uncommon in Biwa Lake.

SYNEDRA VAUCHERIÆ Kütz. var. CAPITELLATA Grun.

Synedra Vaucheriæ Kütz. var. *capitellata* Grun. Fr. Hustedt Bacillar. (1930) 161, fig. 254.

Valve linear-lanceolate with attenuate and capitate ends. Length, 0.015 mm, breadth, 0.0032. Striæ 18 in 0.01 mm. Reported from Kizaki Lake.

SYNEDRA MINUSCULA Grun. var. CAPITATA var. nov. Plate 3, fig. 2.

Differs from the type in its short capitate ends. Length, 0.02 mm, breadth, 0.003. Striæ 15 in 0.01 mm. Uncommon in Biwa Lake.

SYNEDRA PARASITICA W. Sm. Plate 2, fig. 2.

Fragilaria parasitica W. Sm. A. Schmidt Atlas Diatom. (1913) pl. 196, figs. 79-80.

A distinct species with lanceolate valve, enlarged in the middle and attenuate towards the ends. Length, 0.024 mm, breadth, 0.0034. Striæ 18 in 0.01 mm. Common in Biwa Lake. Reported from Kizaki Lake.

SYNEDRA ACUS Kütz. Plate 2, fig. 4.

Synedra acus Kütz. A. Schmidt Atlas Diatom. (1914) pl. 303, fig. 7.

Valve linear-lanceolate. Length, 0.09 mm, breadth, 0.005. Striæ 12 in 0.01 mm. Common in fresh water.

SYNEDRA NIPPONICA Skvortzow. Plate 4, fig. 13.

Synedra nipponica Skvortzow. Diatoms Kizaki Lake (1936) pl. 1, fig. 43.

Valve small, lanceolate, enlarged in the middle gradually attenuate towards the ends. Length, 0.0085 mm, breadth, 0.0019. Striæ 24 in 0.01 mm. Differs from the Kizaki specimen in its coarser striæ.

EUNOTIA GRACILIS Ehr. Rabh. Plate 5, fig. 12.

Eunotia gracilis Ehr. Rabh. Fr. Hustedt Bacillar. (1930) 185, fig. 253.

Valve linear slightly curved, with parallel margins. Ends capitate. Length, 0.05 to 0.093 mm; breadth, 0.004 to 0.005. Striæ 10 in 0.01 mm. Reported from Kizaki Lake.

EUNOTIA PRÆRUPTA Ehr var BIDENS Grun Plate 8, fig. 13.

Eunotia praerupta Ehr var *bidens* Grun., Fr Hustedt Bacillar (1930) 174, fig. 217

Valve robust, genuflexed, undulate with rostrate and truncate ends. Length, 0.083 mm breadth, 0.013 Striæ 8 in 0 01 mm Not common.

EUNOTIA PECTINALIS (Kütz.) Rabh. var MINOR (Kütz.) Rabh.

Eunotia pectinalis (Kütz.) Rabh var *minor* (Kutz.) Rabh Fr Hustedt Bacillar (1930 182 fig. 238.

Valve linear, genuflexed, slightly gibbous in the middle, with short attenuate ends. Length, 0 034 mm, breadth, 0.0042 Striæ 14 in 0 01 mm Reported from Kizak. Lake.

EUNOTIA PECTINALIS (Kütz. Rabh var MINOR (Kütz.) Rabh. fo. IMPRESSA (Ehr.

Eunotia pectinalis (Kütz.) Rabh. var *minor* (Kutz.) Rabh fo. *impressa* (Hustedt) Bacillar (1930) 182, fig 239.

Valve reflexed Length 0 027 mm breadth, 0.0065. Striæ 15 in 0.01 mm Known from Aokiko Lake.

EUNOTIA SUDETICA (O Müll.) Hust. var. NIPPONICA var nov. Plate 2, fig. 15.

Valve genuflexed, gradually attenuate towards the ends Ends slightly capitate, broad rounded Length, 0 037 mm; breadth, 0 005 Striæ 6 in 0.01 mm Differs from the type in its more elongate valves and wider striæ Uncommon

EUNOTIA VENERIS (Kütz. O. Müll.

Eunotia veneris (Kütz.) O. Müll. Fr Hustedt Bacillar 1930) 182-183 fig. 245

Valve linear, straight on the ventral side, reflexed at the dorsal side. Ends acute Length. 0.0187 mm breadth. 0.004 Striæ 15 in 0.01 mm Uncommon

EUNOTIA LUNARIS (Ehr. Grun

Eunotia lunaris (Ehr Grün, Fr Hustedt Bacillar (1930) 183-184, fig. 249.

Valve linear, lunate with parallel margins and rounded ends. Length, 0.052 mm, breadth, 0 004 Striæ 15 in 0 01 mm. Reported from Kizaki Lake

ACTINELLA BRASILIENSIS Grun

Actinella brasiliensis Grun., Skvortzow Diatoms Kizaki Lake (1936 p. 8, fig 11

Valve linear, clavate, broad-capitate and apiculate at the apex, regularly attenuate towards the end Length, 0.08 to 0.09 mm

Not common Reported from Kizaki Lake, Chosen, and Hanka Lake.

COCCONEIS PLACENTULA (Ehr.)

Cocconeis placentula (Ehr.) Fr. Hustedt Bacillar. 1930) 189, fig. 260.

Valve elliptical. Length, 0.04 mm., breadth 0.025. Uncommon. Reported from Aokiko Lake.

COCCONEIS PLACENTULA (Ehr.) var. EUGLYPTA (Ehr.) Cleve.

Cocconeis placentula (Ehr.) var. *euglypta* (Ehr.) Cleve. Fr. Hustedt, Bacillar. (1930) 190, fig. 261.

Differs from the type in its fine, longitudinal, undulating, blank bands. Length 0.0085 mm. breadth 0.0068. Uncommon in Biwa Lake. A fresh-water diatom.

COCCONEIS PLACENTULA (Ehr.) var. LINEATA (Ehr.) Cleve.

Cocconeis placentula Ehr. var. *lineata* (Ehr.) Cleve. Fr. Hustedt Bacillar. (1930) 190, fig. 262.

Valve elliptical, crossed by fine, longitudinal, undulating, blank bands. Length, 0.024 mm., breadth, 0.014. Reported from Kizaki Lake.

COCCONEIS DISCULUS Schum. var. NIPPONICA var. nov. Plate 4, fig. 18.

Broader and smaller than the type form. Length, 0.014 mm. breadth, 0.01. Striæ 10 in 0.01 mm. *Cocconeis disculus* is known from bottoms of European lakes.

COCCONEIS DIMINUTA Pant.

Cocconeis diminuta Pant., Fr. Hustedt Bacillar. (1930) 191-192, fig. 265.

Valve elliptical. Length, 0.01 mm., breadth, 0.0085. Lower valve with very fine striæ, upper valve with more-robust striation. Striæ 18 in 0.01 mm. Reported from Aokiko and Kizaki Lakes. Known from European lakes.

? COCCONEIS OKEGENSIS Wisl. and Kolbe. Plate 5, figs. 4 and 5.

Exocconeis ostrogorskii Wislouch and Kolbe, New diatoms from Russia (1916) Journ. Microbiol. 3: 169–271. pl. 3, figs. 5, 6, Beiträge zur Diatomeenflora des Ohrid-Sees (1927), 33, 72, pl. figs. 2, 3.

Valve robust, lanceolate, broad-undulate at the middle, gradually attenuate towards the ends. Length, 0.03 mm., breadth, 0.015. Upper valve with radiate striæ. Central area oblique, rectangular from one side, dilated on the other side. Axial area narrow, filiform. Lower valve rectangular, with a broad stauros, widened and truncate outwards. Striæ punctate, 18 in

0.01 mm. Uncommon. Known from Onega Lake, northern Europe, Russia.

ACHNANTHES MINUTISSIMA Kütz.

Achnanthes minutissima Kütz. Fr. Hustedt, Bacillar. (1930) 98 fig. 274.

Valve linear-elliptical, attenuate towards the ends. Length, 0.013 mm. breadth. 0.002. Striæ 30 in 0.01 mm. Reported from Kizaki Lake. Common in Biwa Lake.

ACHNANTHES HAUCKIANA Grun. var. NIPPONICA var. nov. Plate 6, fig. 12.

Differs from the type in its rounded ends and slightly undulated middle part. Length, 0.011 mm. breadth, 0.008. Striæ 12 in 0.01 mm. more distinct in the middle part of the valve. Uncommon.

ACHNANTHES CLEVEI Grun. Plate 5, fig. 3.

Achnanthes Clevei Grun., Fr. Hustedt, Bacillar. (1930) 203, fig. 294.

Valve elliptical, lanceolate with attenuate ends. Length, 0.012 mm. breadth 0.0056. Upper valve with a narrow, linear axial area, with robust striæ, 12 in 0.01 mm. Lower valve with outward-dilated central area. Striæ radiate, punctate, 24 in 0.01 mm., in the middle of unequal length. Common. Reported from Aokiko Lake.

ACHNANTHES CLEVEI Grun. var. NIPPONICA Skvortzow. Plate 5, fig. 5.

Achnanthes Clevei Grun. var. *nipponica* Skvortzow. Diatoms Kizaki Lake (1936) pl. 2, fig. 24.

Valve long-elliptical with attenuate ends. Length, 0.027 mm. breadth, 0.0068. Striæ of the upper valve 9, of the lower valve 21, in 0.027 mm. Known from Kizaki Lake.

ACHNANTHES PINNATA Hust. var. JAPONICA Hustedt.

Achnanthes pinnata Hust. var. *japonica* Hustedt. Bacillar. aus dem Aokikosee in Japan 161 pl. 5, figs. 12, 13.

Valve minute, ovate with rounded ends. Length, 0.005 mm., breadth, 0.0027. Striæ 22 in 0.01 mm. Reported from Aokiko and Kizaki Lakes. The type is known from central Asia.

ACHNANTHES PERAGALLII Brun and Heribaud.

Achnanthes Peragallii Brun and Heribaud. Fr. Hustedt. Bacillar. (1930) 207, fig. 300.

Valve lanceolate with abruptly attenuate and capitate ends. Length, 0.01 mm., breadth. 0.006. Reported from Aokiko and Kizaki Lakes.

ACHNANTHES LINEARIS W. Smith fo. MINUTA fo. nov.

Differs from the type in its smaller size. Valve linear-elliptical, slightly siliceous. Length, 0.0068 mm, breadth, 0.002. The type was reported from Aokiko and Kizaki Lakes.

ACHNANTHES AFFINIS Grun. Plate 5, fig. 18.

Achnanthes affinis Grun. FR. HUSTEDT, Bacillar. (1930) 199, fig. 282.

Valve linear-lanceolate, enlarged in the middle part, attenuate and capitate. Length, 0.012 mm; breadth, 0.0025. Striæ very fine, 30 in 0.01 mm. Uncommon.

ACHNANTHES BIASOLETTIANA Kütz. Plate 5, fig. 14.

Achnanthes Biasoletiana Kütz., FR. HUSTEDT, Bacillar. (1930) 199, fig. 289.

Valve broad linear-elliptical, undulate in the middle, broadly rounded at the ends. Length, 0.012 mm; breadth, 0.0053. Striæ very fine, 30 in 0.01 mm. Uncommon.

ACHNANTHES LANCEOLATA nov.

Achnanthes lanceolata Breb., FR. HUSTEDT, Bacillar. (1930) 207, fig. 306*a*.

Valve lanceolate-elliptical with broad ends. Length, 0.012 mm; breadth, 0.005. Striæ 15 in 0.01 mm. Reported from Aokiko and Kizaki Lakes. Common in Biwa Lake.

ACHNANTHES LANCEOLATA Breb. var. ROSTRATA Hust.

Achnanthes lanceolata Breb. var. *rostrata* HUSTEDT, Bacillar. (1930) 208, fig. 306*b*.

Valve with rostrate ends. Length, 0.009 mm; breadth, 0.005. Striæ 12 in 0.01 mm. Reported from Kizaki Lake.

ACHNANTHES LANCEOLATA Breb. var. ELLIPTICA Cleve.

Achnanthes lanceolata Breb. var. *elliptica* Cleve, FR. HUSTEDT, Bacillar. (1930) 208, fig. 306*c*.

Valve broad-elliptical. Length, 0.015 mm, breadth, 0.0068. Known from Kizaki Lake.

ACHNANTHES LANCEOLATA Breb. var. NIPPONICA Skvortzow.

Achnanthes lanceolata Breb. var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 12, fig. 13.

Valve broad-lanceolate, slightly gibbous in the middle, obtuse. Length, 0.015 mm, breadth, 0.005. Striæ 12 in 0.01 mm. Differs from the type in its short valves. Common in Biwa Lake. Reported from Kizaki Lake.

ACHNANTHES EXIGUA Grun. var INDICA Skvortzow

Achnanthes exigua Grun. var *indica* Skvortzow Diatoms from Calcutta 1935 p 1, fig. 3

Valve slightly sigmoid, short. Length, 0.0076 mm., breadth 0 0042. Reported from Calcutta and Kizaki Lake

RHOICOSPHENIA CURVATA (Kütz.) Grun. Plate 2 fig. 14.

Rhoicosphenia curvata (Kütz Grun., Fr. Hustedt. Bacillar. 1930 2:1, fig. 311

Valve linear curvate, attenuate towards the ends. Length 0.042 mm., breadth, 0.0068 Striæ 12 in 0.01 mm. Known from Aokiko and Kizaki Lakes.

RHOICOSPHENIA CURVATA Kütz. Grun. var. MAJOR Cleve. Plate 7, fig. 2.

Rhoicosphenia curvata Kütz.) Grun. var *major* Cleve, Synopsis Navicul. Diatoms 2 (1895) 165.

Larger than the type Length. 0 078 mm., breadth, 0 0085. Striæ 11 in 0.01 mm Known from Pitt River, Oregon, North America Not common in Biwa Lake.

AMPHIPLEURA PELLUCIDA Kütz. var RECTA Hitton.

Amphipleura pellucida Kütz. var. *recta* Kitton, P Cleve, Synopsis Navicul. Diatoms (1894) 1, 127 Skvortzow Diatoms Kizaki Lake 1936) pl 3. fig. 6.

Valve linear with gently cuneate ends Length, 0 25 mm., breadth, 0 017 Known from Kizaki Lake, Nippon, and from southern China. Found by Kitton in stomachs of Nipponese oysters. A fresh water species

FRUSTULIA RHOMBOIDES (Ehr.) de Toni va SAXONICA (Rabh. de Toni fo. NIPPONICA fo. nov. Plate 4, fig. 4.

Valve elliptical, attenuate Length, 0.034 mm., breadth, 0 011 Differs from the type in its broader valves. Not common.

FRUSTULIA RHOMBOIDES Ehr de Toni VAR AMPHIPLEUROIDES Grun.

Frustulia rhomboides (Ehr.) de Toni var. *amphipleuroides* Grun Fr Hustedt, Bacillar. (1930) 221, fig 326.

Valve lanceolate, narrow Length, 0 105 mm., breadth, 0 0.9. Reported from Aokiko and Kizaki Lakes.

FRUSTULIA VULGARIS Thwait var ASIATICA Skvortzow Plate 5 fig. 6.

Frustulia vulgaris Thwait var *asiatica* Skvortzow, Diatoms from N Manchuria (1928) 42, pl. 2. fig 12.

Valve linear-lanceolate with obtuse, truncate, and broad ends. Length, 0.044 mm., breadth, 0.008. Reported from Manchuria and Ceylon.

GYROSIGMA KUTZINGII (Grun.) Cleve.

Gyrosigma Kutzingii Grun. Cleve, Fr. Hustedt Bacillar. (1930) 224, fig. 333.

Valve sigmoid, gradually attenuate towards the ends. Length, 0.105 mm, breadth, 0.0013. Longitudinal striæ 21, transverse striæ 26 in 0.01 mm. Reported from Aokiko and Kizaki Lakes.

GYROSIGMA ACUMINATUM (Kütz.) Rabh.

Gyrosigma acuminatum (Kütz.) Rabh. Fr. Hustedt. Bacillar. (1930) 222, fig. 329.

Valve large and robust. Length 0.184 mm, breadth, 0.02. Longitudinal and transverse striæ 18 in 0.01 mm. Known from Kizaki Lake.

GYROSIGMA SPENCERII (W. Smith) Cleve var. NODIFERA Grun. Plate 3, fig. 4.

Gyrosigma Spencerii (W. Smith) Cleve var. *nodifera* Grun. Fr. Hustedt, Bacillar. (1930) 226, fig. 337.

Valve robust, broad, with rounded, oblique ends. Length, 0.122 mm, breadth, 0.017. Longitudinal striæ 24, transverse 22 to 24, in 0.01 mm. The transverse striæ in the middle part of the valve radiate. Not common. Known from fresh waters.

GYROSIGMA ATTENUATUM (Kütz.) Rabh. var. NIPPONICA var. nov. Plate 7, fig.

Valve broad-linear, slightly sigmoid with attenuate ends. Length, 0.158 to 0.16 mm, breadth 0.0187 to 0.0192. Longitudinal striæ narrow, 21 to 24 in 0.01 mm, in the middle part radiate. Central area oblique, terminal area distinct, obliquely enlarged. Seems to be a distinct species. Not common. Differs from the type in having coarser transverse striæ.

CALONEIS BACILLUM (Grun.) Meresch.

Caloneis bacillum Grun. Meresch., Fr. Hustedt. Bacillar. 1930 235, fig. 360*a*.

Valve linear or linear-lanceolate with paralel margins and rounded ends. Length, 0.037 mm, breadth, 0.007. Striæ 18 in 0.01 mm. Uncommon.

CALONEIS BACILLUM (Grun.) Meresch. var. LANCETTULA (Schulz.) Hustedt. Plate 3, fig. 5.

Caloneis bacillum (Grun.) Meresch. var. *lancettula* (Schulz.) Hustedt. Bacillar. (1930) 236, fig. 361.

Valve lanceolate. Length 0.018 to 0.034 mm, breadth, 0.004 to 0.0085. Striæ 24 to 26 in 0.01 mm. Reported from Aokiko Lake.

CALONEIS BACILLUM (Grun.) Meresch. var LANCETTULA (Schulz) Hust. fo. DENSE-STRIATA fo. nov. Plate 7 fig. 11.

Valve lanceolate with attenuate ends. Length, 0.034 mm., breadth 0.0085. Striæ very fine, about 35 to 40 in 0.01 mm. Differs from variety *lancettula* in its fine striæ. Not common.

CALONEIS SILICULA (Ehr.) Cleve var. TUMIDA Hust.

Caloneis silicula (Ehr.) Cleve var. *tumida* HUSTEDT, Bacillar. (1930) 218, fig. 367.

Valve robust, undulate with attenuate ends. Length, 0.072 to 0.09 mm. breadth, 0.013 to 0.015. Reported from Kizaki Lake.

CALONEIS SILICULA Ehr. var. BAICALENSIS Skv. and Meyer. Plate 6, fig. 9.

Caloneis silicula Ehr. var. *baicalensis* SKVORTZOW and MEYER, Contribut. Diatom. of Baikal Lake (1926) 2, pl. 1, fig. 44.

Valve linear-undulate. Length, 0.04 to 0.052 mm., breadth, 0.0068 to 0.0076. Striæ 20 to 24 in 0.01 mm. Differs from variety *Kjellmaniana* Grun. in its coarser striæ. Reported from Kizaki Lake.

CALONEIS SILICULA Ehr. Cleve var. TRUNCATULA Grun.

Caloneis silicula (Ehr.) Cleve var. *truncatula* Grun., FR. HUSTEDT Bacillar. (1930) 238, fig. 364b.

Valve linear, slightly attenuate with broad rounded ends. Length, 0.045 mm., breadth, 0.01. Reported from Kizaki Lake.

CALONEIS PUNCTATA sp. nov. Plate 3, fig. 18.

Valve broad, linear-elliptical with broad ends and enlarged middle part. Length 0.018 mm., breadth, 0.006. Striæ punctate almost parallel, 15 in 0.01 mm. Puncta about 25 to 30 in 0.01 mm. Axial and central areas very narrow. Median line straight. Uncommon. A form akin to *Caloneis Zachariasi* Reichelt.

CALONEIS NIPPONICA sp. nov. Plate 1, fig. 7. Plate 3, fig. 9. Plate 4, fig. 15.

Valve linear-undulate with broadly truncate and rounded ends. Length 0.042 to 0.06 mm. breadth 0.007 to 0.01. Central area a broad stauros. Striæ radiate, 17 to 18 in 0.01 mm. Median line straight, axial area linear and slightly enlarged. This new species is akin to *Caloneis columbiensis* Cleve, found in Columbia River, Oregon, and to the marine diatom *C. clavigera* Cleve. Common in Biwa Lake.

NEIDIUM DUBIUM (Ehr. Cleve fo. CONSTRICTA Hustedt. Plate 1 fig. 15.

Navicula dubia Ehr.) Cleve fo. *constricta* HUSTEDT. Bacillar. (1930) 246, fig. 384b.

Valve linear, minute. Length, 0.037 mm, breadth, 0.01. Striæ very fine, 24 to 28 in 0.01 mm. Common.

NEIDIUM HITCHCOCKII Ehr.

Neidium Hitchcockii Ehr. A. SCHMIDT, Atlas Diatom. (1877) pl. 43, figs. 35, 36.

Valve triundulate. Length, 0.051 mm, breadth, 0.013. Common. Reported from Aokiko and Kizaki Lakes.

NEIDIUM IRIDIS (Ehr.) Cleve.

Neidium iridis (Ehr.) Cleve, Fr. HUSTEDT, Bacillar. (1930) 245, fig. 379.

Valve linear-lanceolate, attenuate towards the ends. Length, 0.049 to 0.01 mm, breadth, 0.018 to 0.025. Striæ 15 to 20 in 0.01 mm. Uncommon in Biwa Lake. Known from Aokiko Lake.

NEIDIUM OBLIQUESTRIATUM A. S. Plate 2, fig. 12.

Neidium obliquestriatum A. Smith A. SCHMIDT Atlas Diatom. (1877) pl. 49, figs. 41, 42.

Valve triundulate with truncate ends. Length, 0.068 to 0.0153 mm, breadth, 0.012 to 0.025. Striæ oblique, 18 to 24 in 0.01 mm. Median line straight, axial area linear. Uncommon in Biwa Lake. Reported from Demerara River, Brazil, and from Aokiko Lake, Nippon.

NEIDIUM OBLIQUESTRIATUM A. S. var. NIPPONICA Skvortzow.

Neidium obliquestriatum A. S. var. *nipponica* SKVORTZOW Diatoms Kizaki Lake (1936), pl. 4, fig. 22.

Valve lanceolate with attenuate ends. Length, 0.068 mm, breadth, 0.017. Striæ oblique, 21 in 0.01 mm. Common. Reported from Kizaki Lake.

NEIDIUM OBLIQUESTRIATUM A. S. var. ELONGATA var. nov. Plate 2, fig. 1.

Valve linear-lanceolate or linear-elliptical, gradually attenuate to the ends. Length, 0.085 mm, breadth, 0.015. Striæ oblique, 21 to 24 in 0.01 mm. Central area broad, oblique. Differs from the type in its elongate, not triundulate, valves. Common.

DIPLONEIS OVALIS (Hilse) Cleve.

Diploneis ovalis (Hilse) Cleve, Fr. HUSTEDT. Bacillar. 1930) 249, fig. 390.

Valve broad-elliptical with rounded ends. Length, 0.042 mm, breadth, 0.022. Central area broad. Striæ radiate, 10 in 0.01

mm. Puncta 12 in 0.01 mm. Not common. Reported from Aokiko and Kizaki Lakes.

DIPLONEIS OVALIS Hilse. Cleve var. OBLONGELLA (Naegeli) Cleve. Plate 5. fig. 19.

Diploneis ovalis (Hilse) Cleve var. *oblongella* (Naegeli) Cleve. F. Hustedt, Baci lar. (1930) 249, fig. 39.

Valve linear with rounded ends. Length, 0.046 to 0.091 mm. breadth, 0.017 to 0.027. Striæ radiate, 8 to 9 in 0.01 mm. Puncta 15 in 0.01 mm. Reported from Aokiko and Kizaki Lakes. Common in Biwa Lake.

DIPLONEIS OVALIS (Hilse) Cleve var. OBLONGELLA (Naegeli) Cleve fo. NIPPONICA fo. nov. Plate 2. fig. 25.

Valve small, elliptical. Length, 0.02 mm. breadth, 0.0085. Striæ 8 in 0.01 mm. Puncta very fine. Differs from the type in its short valve. Not common.

DIPLONEIS OVALIS Hilse. Cleve var. BIPUNCTATA var. nov. Plate 1, fig. 1.

Valve broad-elliptical, undulate, attenuate towards the ends. Length, 0.03 mm., breadth, 0.02. Striæ bipunctate, 8 to 9 in 0.01 mm. Differs from the type in its bipunctate striæ. Common. Reported by F. Hustedt from Aokiko Lake and related to *Diploneis ovalis*.

DIPLONEIS OVALIS Hilse. Cleve var. NIPPONICA var. nov. Plate 4. fig. 1.

Valve elliptical with attenuate ends. Length, 0.076 mm., breadth, 0.028. Striæ 8 in 0.01 mm. Puncta 15 in 0.01 mm. Differs from variety *oblongella* in its elliptical valve. Uncommon.

DIPLONEIS SMITHII (Breb.) Cleve var. NIPPONICA Skvortzow.

Diploneis Smithii (Breb.) Cleve var. *nipponica* Skvortzow. Diatoms Kizaki Lake (1936) pl. 2, figs. 1–9.

Valve elliptical. Length, 0.06 to 0.085 mm., breadth, 0.03 to 0.04. Differs from the type in its more elongate and attenuate ends. Known from Kizaki Lake.

DIPLONEIS MARGINESTRIATA Hustedt var. NIPPONICA var. nov. Plate 4. fig. 3.

Valve linear-elliptical with broad, rounded ends. Length, 0.039 mm., breadth, 0.016. Striæ 17 in 0.01 mm. Central area rectangular. Differs from the type in its striæ, from axial area to the margin, being without interruption. The type species is reported from Aokiko Lake.

DIPLONEIS PUELLA (Schum) Cleve.

Diploneis puella (Schum.) Cleve, FR. HUSTEDT, Bacillar. (1930) 250 fig. 304.

Valve elliptical, small, with broad ends. Length, 0.02 mm, breadth, 0.01. Striæ radiate, 10 in 0.01 mm. Common. Reported from Kizaki Lake.

STAURONEIS ANCEPS Ehr. var. SIBIRICA Grun.

Stauroneis anceps Ehr. var. *sibirica* Grun., CLEVE and GRUNOW, Arctische Diatomeen (1880) pl. 8, fig. 66.

Valve linear-lanceolate with gradually attenuated ends. Length, 0.051 mm; breadth, 0.013. Central area a broad stauros widened and truncate outwards. Rare.

STAURONEIS ANCEPS Ehr. var. HYALINA Brun and Peragallo.

Stauroneis anceps Ehr. var. *hyalina* Brun and Peragallo, FR. HUSTEDT *Bacillar.* (1930) 256, fig. 408.

Valve lanceolate with long-acuminate ends. Length, 0.054 mm; breadth, 0.01. Striæ very fine, about 30 in 0.01 mm. Uncommon.

STAURONEIS PHOENICENTERON Ehr.

Stauroneis phœnicenteron Ehr., FR. HUSTEDT, Bacillar. (1930) 255, fig. 404.

Valve lanceolate with obtuse ends. Length, 0.095 mm; breadth, 0.017. Striæ radiate, 18 in 0.01 mm. Common. Reported from Aokiko and Kizaki Lakes.

STAURONEIS SMITHII Grun. var. RHOMBICA Meister. Plate 5, fig. 7.

Stauroneis Smithii Grun. var. *rhombica* MEISTER, Beiträge zur Bacillarienkunde, 1930, 228, pl. 8, fig. 5.

Valve rhombic-lanceolate, reflexed in the middle part. Length, 0.013 mm; breadth, 0.005. Striæ 25 in 0.01 mm. Our specimens are smaller than the type from Tokyo.

STAURONEIS SMITHII Grun. var. INCISA Pant.

Stauroneis Smithii Grun. var. *incisa* Pant., FR. HUSTEDT, Bacillar. (1930), 251, fig. 421.

Valve lanceolate-elliptical. Margins not undulate. Length, 0.022 mm; breadth, 0.0068. Reported from Kizaki Lake.

NAVICULA MUTICA Kütz. var. NIPPONICA var. nov. Plate 6, fig. 10.

Valve elliptical with broad ends. Length, 0.032 mm; breadth, 0.01. Striæ 18 in 0.01 mm. Puncta 20 in 0.01 mm. Differs from the type in its broad valve and cuneate ends. Uncommon.

NAVICULA PUPULA Kütz. var. CAPITATA Hustedt.

Navicula pupula Kütz. var. *capitata* Hustedt, Bacillar. (1930) 281, fig. 467c.

Valve linear, slightly undulate at the ends capitate. Length, 0.039 mm, breadth, 0.009. Reported from Kizaki Lake.

NAVICULA PUPULA Kütz. var. RECTANGULARIS (Greg.) Grun.

Navicula pupula Kütz. var. *rectangularis* (Greg.) Grun. Fr. Hustedt, Bacillar. (1930), 281, fig. 467b.

Valve linear-rectangular, ends broad. Length, 0.059 mm, breadth, 0.012. Common. Reported from Kizaki Lake.

NAVICULA LAMBDA Cleve var. NIPPONICA var. nov. Plate 4, fig. 15.

Valve linear with parallel margins, broad with obtuse ends. Length, 0.044 to 0.068 mm., breadth, 0.01 to 0.014. Median line in a thickish sinuous rib. Central area broad. Striæ radiate, 12 to 18 in the middle, 15 to 18 at the ends, in 0.01 mm. The type has constricted valves and is known from Demerara River, South America.

NAVICULA SUBHAMULATA Grun. Plate 7, fig. 10.

Navicula subhamulata Grun., Fr. Hustedt, Bacillar. (1930) 282, fig. 468a.

Valve linear-elliptical with broad rounded ends. Length, 0.012 mm., breadth, 0.005. Striæ slightly radiate, 25 in 0.01 mm. Axial area very narrow. Median line curved at the ends. Not common. A fresh-water species.

NAVICULA SUBHAMULATA Grun. var. PARALLELA var. nov. Plate 5, fig. 11.

Valve broad linear with parallel margins and broad, rounded, and obtuse ends. Length, 0.017 mm., breadth, 0.005. Striæ 18 to 20 in 0.01 mm. Median line straight. Axial area narrow. Differs from variety *undulata* Hust. in its parallel margins and wider striæ. Uncommon.

NAVICULA CRUCICULA W. Smith Donkin var. OBTUSATA Grun. Plate 8, fig. 9.

Navicula cruciculus (W. Smith) Donkin var. *obtusata* Grun. Fr. Hustedt, Bacillar. (1930) 284.

Valve broad-lanceolate with slightly attenuate ends. Length, 0.027 mm., breadth, 0.0[illegible]. Striæ radiate, 24 in the middle, 30 at the ends, in 0.01 mm. Axial area narrow, central area somewhat dilated in the middle part. Uncommon. A brackish-water diatom.

NAVICULA ATOMUS (Naegeli) Grun.

Navicula atomus (Naegeli) Grun., Fr Hustedt Bacillar (1930) 283 fig. 484.

Valve elliptical with rounded ends. Length, 0.0085 mm, breadth, 0.0042. Striæ 25 in 0.01 mm. Common in fresh water.

NAVICULA PSEUDOSCUTIFORMIS Hust.

Navicula pseudoscutiformis Hustedt, Bacillar. 1930. 391 fig. 495.

Valve broad-elliptical, almost round, with broad rounded ends. Length 0.012 mm, breadth 0.01. Axial area very narrow, central area somewhat dilated. Median line straight. Striæ radiate, in the middle alternately longer and shorter. Common in northern Europe. Reported from Kizaki Lake.

NAVICULA CRYPTOCEPHALA Kütz.

Navicula cryptocephala Kütz. Fr Hustedt. Bacillar. (1930) 395, fig. 496.

Valve lanceolate with attenuate ends. Length, 0.019 to 0.025 mm, breadth, 0.0042 to 0.005. Axial area narrow, widened in the middle part. Striæ radiate, 15 to 18 in 0.01 mm. Not common. Reported from Kizaki Lake.

NAVICULA RHYNCHOCEPHALA Kütz.

Navicula rhynchocephala Kütz. Fr Hustedt Bacillar. (1930) 298 fig. 501.

Valve lanceolate with long ends. Length, 0.039 mm, breadth, 0.01. Central area broad. Striæ radiate, 13 to 14 in 0.01 mm. Not common. Reported from Aokiko and Kizaki Lakes.

NAVICULA ROSTELLATA Kütz. var. BIWENSIS var. nov. Plate 1, fig. 14.

Valve lanceolate with gradually attenuate ends. Length, 0.025 to 0.027 mm, breadth, 0.005. Axial area narrow. Central area dilated. Striæ 11 to 15 in 0.01 mm. Differs from the type in its regular lanceolate valves and coarser striæ. Uncommon.

NAVICULA COSTULATA Grun. fo. CURTA fo. nov. Plate 6, fig. 13.

Valve broad, rhomboid-lanceolate. Length, 0.009 mm, breadth, 0.0042. Striæ robust, radiate, 10 in 0.01 mm. Central area a broad rectangular stauros. Our specimens are shorter than the type. *Navicula costulata* is known from the bottoms of European lakes.

NAVICULA COSTULATA Grun. var. NIPPONICA var. nov. Plate 5, fig. 12.

Valves rhomboid-lanceolate with subrostrate ends. Length, 0.012 mm. Breadth, 0.0042. Striæ robust, almost parallel, 9 in

0.01 mm. Differs from the type in its subrostrate ends. Common.

NAVICULA COSTULATA Grun. var. TENUIROSTRIS var. nov. Plate 2, fig. 16.

Valve lanceolate, undulate at the middle, long-attenuate at the ends. Length, 0.027 mm, breadth 0.007. Costæ radiate, 6 in 0.01 mm. Central area a wide staurus. Differs from the type in its elongate ends. Uncommon.

NAVICULA RADIOSA Kütz. fo. NIPPONICA fo. nov. Plate 2, fig. 2. Plate 3, fig. 24.

Valve narrow lanceolate, gradually attenuate, acuminate. Length, 0.04 to 0.042 mm, breadth, 0.0068 to 0.0085. Axial area narrow, linear, dilated in the middle. Striæ radiate, not lineolate, 8 to 11 in 0.01 mm. Differs from the type in its narrower valves. The type is known from Aokiko Lake.

NAVICULA PEREGRINA (Ehr.) Kütz. var. NIPPONICA var. nov. Plate 4, fig. 6.

Valve lanceolate, parallel in the middle part with abruptly attenuate ends. Length, 0.066 mm, breadth, 0.012. Striæ radiate, lineolate, 6 to 8 in 0.01 mm. Central area broad. Differs from the type in its parallel margins and abruptly attenuate ends. Not common.

NAVICULA RENISCULUS Schum. Plate 4, fig. 7. Plate 6, fig. 13.

Valve elliptical-lanceolate, broad in the middle and gradually attenuate towards the ends. Length, 0.027 to 0.042 mm, breadth, 0.01 to 0.012. Striæ radiate, lineolate, in the middle alternately longer and shorter, 8 to 11 in 0.01 mm. Common. Reported from Kizaki Lake.

NAVICULA REINHARDTII Grun.

Navicula Reinhardtii Grun., FR. HUSTEDT, Bacillar. (1930) 301, fig. 519.

Valve elliptical with broad, obtuse ends. Length, 0.051 mm, breadth, 0.015. Striæ radiate, lineolate, 7 to 8 in 0.01 mm. Not common. A fresh-water species.

NAVICULA SALASIENSIS Grun. var. NIPPONICA Skvortzow. Plate 2, fig. 3.

Navicula salasiensis Grun. var. *nipponica* SKVORTZOW, Diatoms Kizaki Lake, 1936, pl. 6, fig. 15.

Valve linear-lanceolate with parallel margins and subrostrate ends. Length, 0.015 mm, breadth, 0.005. Axial area almost round. Striæ slightly radiate, 18 in 0.01 mm. Differs from the type in its short valves. Reported from Kizaki Lake.

NAVICULA DECEPTA (Ehr. W. Smith var. NEGLECTA Krasske) Hust. Plate 6, fig. 28.

Navicula decepta (Ehr. W. Smith var. *neglecta* Krasske) HUSTEDT Bacillar. (1930) 363, fig. 527.

Valve broad-linear or linear-lanceolate, undulate with rostrate ends. Length, 0.018 mm; breadth, 0.0068. Striæ radiate, 15 in 0.01 mm. Central area rectangular. The type was reported from Aokiko Lake. Uncommon.

NAVICULA PLACENTULA (Ehr.) Grun. Plate 7, fig. 7.

Navicula placentula Ehr. Grun., FR. HUSTEDT Bacillar. (1930) 393, fig. 532.

Valve elliptical-lanceolate with rostrate ends. Length, 0.027 mm, breadth, 0.0085. Striæ radiate, not punctuate, 9 to 10 in 0.01 mm. Rare.

NAVICULA PLACENTULA (Ehr.) Grun. fo. ROSTRATA A. Mayer

Navicula placentula (Ehr.) Grun. fo. *rostrata* A. Mayer FR. HUSTEDT Bacillar. (1930) 393–394, fig. 533.

Valve elliptical-lanceolate with rostrate ends. Length, 0.04 mm; breadth, 0.017. Striæ 10 in 0.01 mm. Reported from Kizaki Lake.

NAVICULA CASTRUM Ehr. fo. NIPPONICA fo. nov. Plate 4, fig. 8.

Valve broad elliptical lanceolate with rostrate ends. Length, 0.29 mm, breadth, 0.01. Striæ radiate, 10 to 11 in 0.01 mm; in the middle alternately longer and shorter. Differs from the type in its rostrate ends. Not common.

NAVICULA EXIGUA (Greg.) O. Müll.

Navicula exigua (Greg.) O. Müll., FR. HUSTEDT, Bacillar. (1930) 395, fig. 538.

Valve elliptical-lanceolate with abruptly attenuate and capitate ends. Length, 0.02 mm, breadth, 0.006. Striæ radiate, in the middle alternately longer and shorter, 15 in 0.01 mm. Reported from Aokiko and Kizaki Lakes.

NAVICULA LANCEOLATA (Agardh) Kütz. var. NIPPONICA var. nov. Plate 3, fig. 14; Plate 7, fig. 5.

Valve narrow, arcuate, gradually attenuate. Length, 0.056 to 0.091 mm, breadth, 0.0068 to 0.01. Striæ 10 to 11 in 0.01 mm. Differs from the type in its narrow valves. *Navicula lanceolata* is known from Aokiko Lake.

NAVICULA LANCEOLATA Agardh Kütz. var. CYMBULA (Donk.) Cleve.

Navicula lanceolata (Agardh) Kütz var *cymbula* (Donk.) Cleve, VAN HEURCK Synopsis (1880-1881) pl. 7, fig. 32.

Valve lanceolate with long-acuminate ends. Length, 0.051 mm., breadth, 0.01. Striæ in the middle 3, at the ends 10, in 0.01 mm. Known from Kizaki Lake. Common in Biwa Lake.

NAVICULA HASTA Pant.

Navicula hasta Pant., Fr. HUSTEDT Bacillar. (1930) 306, fig. 541, SKVORTZOW Diatoms Kizaki Lake (1934) pl. 5, fig. 1.

Valve lanceolate with attenuate and slightly enlarged ends. Length, 0.127 mm, breadth 0.018. Striæ 6 in 0.01 mm. Very common in Biwa Lake. Known from Europe, as a fossil in Hungary, and from Aomiko and Kizaki Lakes, Nippon.

NAVICULA HASTA Pant. var. GRACILIS var. nov. Plate 1, fig. 9.

Valve with long-attenuate ends. Length, 0.051 mm., breadth, 0.01. Striæ radiate, punctate, 9 in 0.01 mm. Differs from the type in its gradually attenuate ends and smaller size. A form related to *Navicula lanceolata* var *cymbula*. Not common.

NAVICULA (NOT LATA sp. nov. Plate 4, fig. 3. Plate 7, fig. 1.

Valve elliptical-lanceolate, undulate with attenuate ends. Length, 0.054 to 0.064 mm. breadth, 0.013 to 0.015. Striæ radiate, lineolate, 7 to 8 in 0.01 mm. Axial area narrow, central area rounded. A species related to *Navicula hasta* Pant.

NAVICULA TUSCULA Ehr. Grun. var DENSISTRIATA var. nov. Plate 4, fig. 9.

Valve elliptical, attenuate and capitate. Length, 0.024 to 0.025 mm. breadth, 0.007 to 0.01. Striæ crossed by four, broad, longitudinal, undulate bands, 20 to 24 in 0.01 mm. Differs from the type in its coarser striæ. Uncommon.

NAVICULA PUSIO Cleve.

Navicula Pusio Cleve, Synopsis Navicul. Diatom. (1895) 9, pl. 2, fig. 3.

Valve elliptical with broad rostrate ends. Length, 0.017 mm., breadth, 0.0076. Striæ fine, about 24 to 28 in 0.01 mm. Common. Known from Rotorua Lake, New Zealand, and Aokiko and Kizaki Lakes, Nippon.

NAVICULA PUSIO Cleve fo. MINUTA fo. nov.

Differs from the type in its smaller size. Length, 0.01 mm., breadth, 0.0034. Rare.

NAVICULA SIMI JB Krasske var NIPPONICA var nov Plate 3, fig. 2.

Valve broad-elliptical with broad rostrate ends Length 0 018 mm breadth 0 0068. Striæ radiate in the middle of unequal length 17 to 18 in 0.01 mm Central area almost rectangular Differs from the type in its striæ of unequal length in the middle part of the valve. Rare.

NAVICULA PALEA Skvortzow.

Navicula palea Skvortzow Diatoms Kizak Lake (1936) pl. 8, fig. 4.

Valve linear, lanceolate, narrow, attenuate with slightly capitate ends Length, 0 025 mm, breadth, 0.0045 Striæ radiate 15 in 0.01 mm. Known from Kizak Lake.

NAVICULA SCUTELLOIDES W Sm. Plate 2 fig. 1

Navicula scutelloides W Sm A SCHMIDT Atlas Diatom (1875) pl. 6, fig. 34.

Valve broad-elliptical with broad rounded ends Length 0 015 to 0.02 mm breadth, 0 011 to 0.014 Median line straight Axial area somewhat dilated in the middle. Striæ radiate in the border, of unequal length 10 to 15 in 0.01 mm puncta distinct 18 in 0 01 mm Rare A distinct species by the structure of the valve related to *Cocconeis pliocaenica* Krasske known from the Upper Pliocene of Germany

NAVICULA SOODENSIS Krasske. Plate 5 fig. 3

Navicula soodensis Krasske, FR HUSTEDT Bacillar (1930) 276 fig 457

Valve linear-elliptical with almost parallel margins and obtuse ends Length 0 023 mm, breadth 0 005. Striæ slightly radiate, 18 in 0.01 mm Median line filiform, straight Axial area very narrow. Central area a broad rectangular stauros The type is known from brackish water in Europe.

NAVICULA KAWAMURAE sp. nov. Plate 5 fig. 11.

Valve lanceolate, undulate at the middle, abruptly attenuate at the ends. Length, 0 027 mm, breadth, 0.0045 Striæ parallel, 18 to 20 in 0.01 mm Axial area a broad fascia, reaching one-third of the valve length Not common Named in honor of Prof Dr T Kawamura, of Kyoto.

NAVICULA MUTA sp. nov. Plate 3, fig. 17.

Valve rhombic-elliptic, broad and acute. Length, 0.015 mm breadth 0 005. Striæ parallel, 24 in 0 01 mm. Median line straight Axial area linear, slightly enlarged Central area a broad fascia reaching about one-third of the valve length. Belongs to Navicula Lanceolatæ Cleve Not common

NAVICULA ACHNANTHOIDES sp. nov. Plate 7. fig. 8.

Valve lanceolate-elliptical, with parallel margins, and gradually attenuate towards the ends. Length, 0.049 mm. breadth 0.01. Median line straight, not reaching the ends. Axial area linear, central area broad and orbicular. Striæ 11 to 12 in the middle, 16 to 17 at the ends, in 0.01 mm. Both ends with transverse, rounded, siliceous ribs. Uncommon.

NAVICULA NIPPON sp. nov. Plate 3. fig. 17.

Valve elliptical or rhombo-dal with parallel margins and broad rostrate ends. Length, 0.024 mm. breadth, 0.0068. Median line straight, central pores curved in the same direction. Axial area narrow, central area a broad, widened rectangular stauros. Striæ slightly radiate, divergent in the middle, convergent at the ends. Common.

PINNULARIA UNDULATA Grog. var. NIPPONICA var. nov. Plate 4. fig. 12. Plate 5. fig. 2.

Valve lanceolate-elliptica with triundulate, attenuate, and rounded ends. Length, 0.04 to 0.068 mm., breadth, 0.0068 to 0.01. Striæ 18 in 0.01 mm. Axial area narrow, central area a broad stauros. Differs from variety *subundulata* Grun. in its broad stauros.

PINNULARIA MOLARIS Grun.

Pinnularia molaris Grun. Fr. Hustedt Bacillar. (1930) 3.6, fig. 568.

Valve linear or linear-lanceolate with slightly attenuate and rounded ends. Length 0.02 mm., breadth 0.005. Striæ 18 in 0.01 mm. Central area a broad stauros. Common. Reported from Hizaki Lake.

PINNULARIA INTERRUPTA W. Smith.

Pinnularia interrupta W. Smith. Fr. Hustedt Bacillar. 1930. 3.7. fig. 573.

Valve linear with parallel margins and capitate ends. Length, 0.04 mm., breadth, 0.0068. Striæ divergent in the middle and convergent at the ends, 10 to 11 in 0.01 mm. Common. Known from fresh water.

PINNULARIA BRAUNII (Grun.) Cleve var. AMPHICEPHALA A. Mayer) Hust. fo. NIPPONICA fo. nov. Plate 2. fig. 20.

Valve elliptical-lanceolate with capitate ends. Length, 0.034 mm. breadth, 0.0068. Striæ 15 in 0.01 mm. Differs from the type in its slightly constricted margins. Uncommon.

PINNULARIA BRAUNII (Grun.) Cleve var. NIPPONICA var. nov. Plate 5. fig. 3.

Valve elliptical-lanceolate with parallel margins and rostrate obtuse ends. Length, 0.032 mm., breadth, 0.006. Striæ 15 in

0.01 mm. Differs from variety *amphicephala* in its rostrate and capitate ends. Uncommon.

PINNULARIA POLYONCA Breb. O. Müll var. NIPPONICA var. nov. Plate 6, fig. 3.

Valve lanceolate with undulate margins. Ends subtruncate. Length, 0.047 mm., breadth, 0.0075. Striæ radiate, 11 to 12 in 0.01 mm. Differs from the type in having narrow, not capitate, ends and a broad middle part. Uncommon.

PINNULARIA KARELICA Cleve var. JAPONICA Hust.

Pinnularia karelica Cleve var. *japonica* Hustedt, Bacillar. aus dem Aokikosee in Japan, 65, pl. 5, fig. 3.

Valve linear, slightly enlarged in the middle part, rounded and capitate at the ends. Length, 0.051 mm., breadth, 0.012. Reported from Aokiko and Kizaki Lakes.

PINNULARIA PLATYCEPHALA Ehr.) Cleve var. HATTORIANA Meister.

Pinnularia platycephala (Ehr.) Cleve var. *Hattoriana* Meister, Beiträge zur Bac. flor. Japans, 214, 2, 228–229, pl. 8, figs. 6, 7.

Valve linear, undulate with capitate ends. Length, 0.074 mm., breadth, 0.009. Striæ radiate, interrupted in the middle part, 9 in 0.01 mm. Reported from Tokyo, Kizaki Lake, in Nippon, from Poyang Lake, Hunan, China, and from Battater, Scotland.

PINNULARIA PLATYCEPHALA Ehr.) Cleve var. HATTORIANA Meister fo. ANGUSTIOR fo. nov. Plate 7, fig. 3.

Valve linear, undulate with subtruncate ends. Length, 0.081 mm., breadth, 0.01. Striæ radiate, 8 in 0.01 mm. Differs from variety *Hattoriana* in its narrower valves. Uncommon.

PINNULARIA BOREALIS Ehr.

Pinnularia borealis Ehr. Fr. Hustedt, Bacillar. (1930), 326, fig. 587.

Valve linear or linear-elliptica with broad rounded ends. Length, 0.034 mm., breadth, 0.008. Common. Reported from Kizaki Lake.

PINNULARIA GIBBA Ehr. Plate 5, fig. 2.

Pinnularia gibba Ehr. Fr. Hustedt, Bacillar. (1930), 321, fig. 600.

Valve linear-lanceolate with slightly apiculate apex. Length, 0.056 to 0.058 mm., breadth, 0.0076 to 0.0085. Striæ radiate, 9 in 0.01 mm. Common. Reported from Kizaki Lake.

PINNULARIA GIBBA Ehr. var. HIWENSIS var. nov. Plate 2, fig. 6.

Valve broad with slightly capitate and attenuate apex. Length, 0.066 mm., breadth, 0.009. Striæ divergent in the middle, convergent at the ends, 11 to 12 in 0.01 mm. Median line

with long terminal, reflexed fissures Differs from variety *nipponica* Skv by its capitate ends.

PINNULARIA ACROSPHAERIA Breb. var LAEVIS Cleve.

Pinnularia acrosphaeria A SCHMIDT Atlas Diatom. 1876) pl. 43. fig 18

Valve linear, more or less gibbous in the middle and at the ends. Length, 0 061 mm., breadth, 0 01 Axial area broad hyaline. Striæ 9 to 10 in 0 01 mm Known from New Zealand and from the Blue Mountains, Australia.

PINNULARIA MACILENTA Ehr Cleve.

Pinnularia macilenta Ehr Cleve Fr. HUSTEDT Bacillar (1930 331, fig. 613

Valve linear with parallel margins and broad rounded ends Length, 0.183 mm breadth, 0 025 Costæ almost parallel, 5 in 0.01 mm. Known from Europe.

PINNULARIA MAJOR Kütz Cleve var. LINEARIS Cleve

Pinnularia major (Kütz Cleve var *linearis* Cleve FR HUSTEDT, Bacillar 1930) WM, PANTOCSEK Fossile Bacillar Ungarns (1901) 3, p. 7, fig. 113

Valve linear with broad rounded ends. Length, 0 161 mm., breadth, 0 022 Striæ 6 in 0.01 mm Axial area enlarged. Central area outwardly dilated. Common Reported from Kizaki Lake.

PINNULARIA MAJOR (Kütz) Cleve var NIPPONICA var. nov Plate 8 fig 6.

Valve linear with parallel margins and abruptly attenuate and subrostrate ends Length, 0.153 mm, breadth 0 017 Striæ radiate, divergent in the middle convergent at the ends, 6 in 0.01 mm Differs from the type in its subrostrate and narrower valves Uncommon

PINNULARIA VIRIDIS (Nitzsch Ehr var PALLAX Cleve. Plate 8, fig 11

Pinnularia viridis Nitzsch Ehr var *pallax* Cleve Fr HUSTEDT Bacillar 1930 335.

Valve linear obtuse at the ends Length, 0 042 to 0 052 mm breadth, 0.01 to 0 013. Striæ 8 to 9 in 0.0 mm Striæ from one side of the valve abrupt Reported from Kizaki Lake.

PINNULARIA VIRIDIS (Nitzsch Ehr var LEPTOGONGYLA Ehr Grun Cleve. Plate 6. fig 10.

Pinnularia viridis (Nitzsch) Ehr var *leptogongyla* (Ehr Grun Cleve. FR. HUSTEDT, Bacillar. 1930, 336.

Valve linear with broad rounded ends Length, 0.051 mm, breadth 0 0.2 Striæ 9 to 10 in 0 01 mm Central area broadly rounded Not common Reported from Kizaki Lake

PINNULARIA NAKAII sp. nov. Plate 1, fig. 4.

Valve lanceolate-linear in the middle slightly undulate, gradually attenuate towards the ends. Ends slightly capitate, acuminate. Length 0.99 mm., breadth 0.012. Median line straight with large comma-shaped, terminal fissures. Axial area narrow-linear, broadened towards the central area. Central area a broad stauros, truncate outwards. Costæ radiate, divergent in the middle, convergent at the ends, without a longitudinal band. Not common. Named in honor of Prof. Dr. T. Naka of Tokyo.

PINNULARIA CAPITATA sp. nov. Plate 1, fig. 3.

Valve broad-linear almost rectangular with broad rounded ends. Length 0.105 mm., breadth 0.02. Median line filiform, with strong, curved, terminal fissures. Axial area linear, dilated from both sides. Central area round. Striæ curved, divergent in the middle, convergent at the ends, 7 to 9 in 0.01 mm., with two longitudinal lines. Common.

PINNULARIA STRIATULA sp. nov. Plate 3, fig. 5.

Valve linear-lanceolate with parallel margins, slightly attenuate, and with broad rounded ends. Length 0.054 mm., breadth, 0.0068. Median line linear, terminal fissures comma-shaped. Axial area very narrow, central areas slightly dilated. Striæ parallel striolate, 11 to 12 in 0.01 mm. Uncommon.

PINNULARIA LACUS BIWÆ sp. nov. Plate 3, fig. 4.

Valve elliptical-lanceolate with capitate ends. Length 0.085 mm., breadth, 0.018. Median line straight, with large comma-shaped terminal fissures. Axial area broad, passing into a broad central area forming a stauros, truncate outwards. Striæ divergent in the middle, convergent at the ends, 9 in 0.01 mm. Longitudinal lines absent. Common.

PINNULARIA KAWAMURÆ sp. nov. Plate 1, fig. 12.

Valve elliptical-lanceolate, middle part undulate, gradually attenuate towards the ends. Length, 0.088 mm., breadth, 0.018. Median line filiform, enlarged in the middle part. Axial areas broad, passing into a broad central area, forming a broad truncate stauros. Striæ radiate, 8 to 9 in 0.01 mm., with two longitudinal bands. Named in honor of Prof. Dr. T. Kawamura, of Kyoto.

PINNULARIA NIPPONICA Skvortzow Plate 8, fig. 8 Plate 8, fig. 5

Pinnularia nipponica Skvortzow Diatoms Kizaki Lake (1936) p. 7 fig. 12

Valve linear-lanceolate, constricted in the middle, attenuate and subrostrate at the ends. Length, 0.068 to 0.076 mm. breadth, 0.012 to 0.013. Costæ divergent in the middle and convergent at the ends, forming a stauros in the middle part. Median line filiform with comma-shaped terminal fissures. Longitudinal bands distinct. Common. A species related to *Pinnularia esox* Ehr. Reported from Kizaki Lake.

AMPHORA OVALIS Kütz.

Amphora ovalis Kütz. FR. HUSTEDT, Bacillar. (1930) 342, fig. 628.

Valve broad-elliptical with curved axial area. Length, 0.051 mm., breadth, 0.018. Not common. Reported from Aokiko Lake.

AMPHORA OVALIS Kütz. var LIBYCA Ehr.) Cleve. Plate 4, fig. 1

Amphora ovalis Kütz. var *libyca* Ehr. Cleve A. SCHMIDT Atlas Diatom. (1875) pl. 26, fig. 105.

Differs from the type in its narrow valves. Length 0.032 to 0.064 mm. breadth, 0.007 to 0.025. Striæ 10 to 12 in 0.01 mm. Reported from Kizaki Lake.

AMPHORA OVALIS Kütz. var PEDICULUS Kütz.

Amphora ovalis Kütz. var *pediculus* Kütz., FR. HUSTEDT Bacillar. (1930) 343, fig. 622.

Valve very small. Length, 0.013 mm., breadth, 0.004. Striæ 15 in 0.01 mm. Known from Aokiko and Kizaki Lakes.

AMPHORA PERPUSILLA Grun.

Amphora perpusilla Grun., FR. HUSTEDT Bacillar. (1930) 343, fig. 627.

Valve elliptical, slightly siliceous. Length, 0.0085 mm., breadth, 0.002. Striæ 22 in 0.01 mm. Reported from Kizaki Lake.

AMPHORA DELPHINEA Bailey) A. S. var MINOR Cleve.

Amphora delphinea Bailey) A. S. var *minor* CLEVE, Synopsis Naviculoid Diatom. (1895) 2, 134, A. SCHMIDT Atlas Diatom. (1876) pl. 40, fig. 25, SKVORTZOW, Diatoms Kizaki Lake (1926) pl. 3, fig. 12.

Frustule elliptical-rectangular. Length, 0.037 mm., breadth, 0.017. This American species is not common in Biwa Lake. Found also in Kizaki Lake.

CYMBELLA CUSPIDATA Kütz.

Cymbella cuspidata Kütz. A. SCHMIDT, Atlas Diatom. (1875) pl. 9, figs. 50, 53-55.

Valve broad, lanceolate with abruptly attenuate ends. Length, 0.049 to 0.054 mm, breadth, 0.012 to 0.02. Striæ 9 to 11 in 0.01 mm. Common. Reported from Kizaki Lake.

CYMBELLA PROSTATA (Berkeley) Cleve.

Cymbella prostata (Berkeley) Cleve, VAN HEURCK, Synopsis (1880-1881) 66, pl. 9, figs. 9-11.

Valve boat-shaped with gibbous dorsal and slightly concave ventral margins. Length, 0.051 mm, breadth, 0.01. Striæ dorsal, 7, ventral, 8, in 0.01 mm. A species typical of Arctic and alpine regions. Reported from Aokiko and Kizaki Lakes.

CYMBELLA HETEROPLEURA Ehr. var. MINOR Cleve.

Cymbella sp. A. SCHMIDT, Atlas Diatom. (1875) p. 9, figs. 51, 52.

Valve with rostrate and truncate ends. Length, 0.062 mm, breadth, 0.018. Striæ 8 in 0.01 mm. An Arctic diatom known from Spitsbergen, Beeren Island, Norway, Scotland, Siberia, and Aokiko Lake.

CYMBELLA HYBRIDA Grun.

Cymbella hybrida Grunow, SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 5, fig. 23.

Valve naviculiform with truncate ends. Length, 0.06 to 0.074 mm, breadth, 0.0085 to 0.01. Striæ lineolate, 8 in 0.01 mm. Reported from Kizaki Lake. Common in Biwa Lake.

CYMBELLA TUMIDA (Breb.) Van Heurck.

Cymbella tumida (Breb.) Van Heurck, F. HUSTEDT, Bacillar. (1930) 366, fig. 647.

Valve cymbiform with rostrate ends. Striæ divergent in the middle convergent at the ends. Length, 0.045 mm, breadth, 0.015. Not common. Reported from Aokiko and Kizaki Lakes.

CYMBELLA TUMIDA (Breb.) Van Heurck var. BOREALIS Grun.

Cymbella tumida (Breb.) van Heurck var. *borealis* Grun., SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 21, fig. 16.

Differs from the type in the valve being not attenuate at the ends. Length, 0.072 mm, breadth, 0.019. Reported from Aokiko and Kizaki Lakes.

CYMBELLA CISTULA (Hemprich) Grun.

Cymbella cistula (Hemprich) Grun. Fr. Hustedt, Bac. Bar (1930) 358 fig. 576a.

Valve lunate, undulate. Length 0.062 to 0.068 mm., breadth, 0.012 to 0.013. Striæ 8 to 10 in 0.01 mm. Near the central nodule the striæ are interrupted by two puncta. Known from Aokiko and Kizaki Lakes.

CYMBELLA SINUATA Greg.

Cymbella sinuata Greg., Fr. Hustedt, Bac. ar. (1930) 361 fig. 668a, b.

Valve asymmetrical, lanceolate, obtuse. Length, 0.012 mm., breadth, 0.004. Striæ 15 in 0.01 mm. Reported from Aokiko and Kizaki Lakes.

CYMBELLA VENTRICOSA Kütz.

Cymbella ventricosa Kütz., Fr. Hustedt, Bacillar. (1930) 359, fig. 661.

Valve asymmetrical with acute ends. Length, 0.028 mm., breadth, 0.007. Striæ 9 in 0.01 mm. Also reported from Aokiko and Kizaki Lakes.

CYMBELLA TUMIDULA Grun.

Cymbella tumidula Grun., A. Schmidt Atlas Diatom. (1874) pl. 376. figs. 14, 15.

Valve broad-elliptical with rostrate, slightly acuminate ends. Length, 0.031 mm., breadth, 0.01. Striæ 10 to 11 in 0.01 mm. Near the central nodule two isolated puncta. Common in Biwa Lake. Known from tropical districts.

CYMBELLA TURGIDULA Grun. var. NIPPONICA var. nov. Plate 2, fig. 5. Plate 4, fig. 4.

Valve boat-shaped with rostrate ends. Median line arcuate. Length 0.037 mm., breadth 0.01. Striæ 10 in 0.01 mm. Near the central area two isolated puncta. Differs from the type in its elongate valve, slightly undulate ventral margin and broad rostrate ends. Common.

CYMBELLA LATA Grun. var. NIPPONICA var. nov. Plate 3, fig. 5.

Valve asymmetrical with subrostrate ends. Length, 0.039 mm., breadth, 0.012. Striæ robust, 10 in 0.01 mm. Differs from the type in its asymmetrical valve and undulate dorsal margin. Not common.

CYMBELLA NIPPONICA sp. nov. Plate 4, figs. 28 and 29.

Valve broad-elliptical with undulate margin and rostrate or subrostrate ends. Length, 0.029 mm., breadth, 0.013 to 0.015.

Striæ robust, radiate, striolate, in the middle alternately longer and shorter with one isolated punctum, 8 to 12 in 0.01 mm. Uncommon.

DIDYMOSPHENIA GEMINATA Lyngb. M. Schmidt. Plate 2 fig. 16.

Didymosphenia geminata (Lyngb.) M. Schmidt, Fr. Hustedt Bacillar. (1930) 367, fig. 682.

Valve clavate, robust. Length, 0.132 mm., breadth, 0.04. Rare. Common in alpine regions.

GOMPHONEMA PARVULUM (Kütz.) Grun.

Gomphonema parvulum (Kütz.) Grun., Fr. Hustedt Bacillar. (1930) 372, fig. 743a.

Valve lanceolate-attenuate towards the ends. Length, 0.02 mm., breadth, 0.005. Striæ 12 in 0.01 mm. Known from Kizaki Lake.

GOMPHONEMA PARVULUM (Kütz.) Grun. var. EXILISSIMA Grun. Plate 2 fig. 4.

Gomphonema parvulum (Kütz.) Grun. var. *exilissima* Grun. Van Heurck, Synopsis (1880-1881) pl. 35, fig. 12.

Valve narrower than that of the type. Length, 0.015 to 0.018 mm., breadth, 0.005 to 0.006. Striæ 15 in 0.01 mm. Isolated puncta indistinct. Reported from Kizaki Lake.

GOMPHONEMA BERGGRENII Cleve. Plate 5, fig. 12.

Gomphonema Berggrenii Cleve, A. Schmidt, Atlas Diatom. (1902) pl. 240, fig. 28.

Valve elliptical, clavate, with capitate apex, broad middle part, attenuate towards the end. Length, 0.035 mm., breadth, 0.008. Striæ 8 in 0.01 mm. Reported from New Zealand and Kizaki Lake.

GOMPHONEMA ACUMINATUM Ehr. var. CORONATA (Ehr.) W. Smith.

Gomphonema acuminatum Ehr. var. *coronata* (Ehr.) W. Smith. Fr. Hustedt, Bacillar. (1930) 370, fig. 684.

Valve clavate, biconstricted with apiculate apex. Length, 0.072 mm., breadth, 0.011. Not common. Known from Kizaki Lake.

GOMPHONEMA CONSTRICTUM Ehr. var. CAPITATA Ehr.) Cleve.

Gomphonema constrictum Ehr. var. *capitatum* Ehr. Cleve, Fr. Hustedt, Bacillar. (1930) 377, fig. 715.

Valve clavate with broad apex. Length, 0.03 to 0.042 mm., breadth, 0.0085. Striæ 12 to 14 in 0.01 mm. Reported from Aoki-ko and Kizaki Lakes.

GOMPHONEMA INTRICATUM Kütz.

Gomphonema intricatum Kütz., Fr. Hustedt Bacillar. (1930) 375 fig. 697

Valve clavate, elongate, apex slightly capitate middle little undulate. Length, 0.028 mm, breadth, 0.004 Reported from Kizaki Lake

GOMPHONEMA INTRICATUM Kütz. var. PUMILA Grun. Plate 3, fig. 12

Gomphonema intricatum Kütz. var. *pumila* Grun., Fr. Hustedt. Bacillar (1930) 375, fig. 699

Valve minute, lanceolate with attenuate and rounded ends Length 0.015 mm, breadth 0.0028. Striæ 15 in 0.01 mm. Common. With the type

GOMPHONEMA AUGUR Ehr. var. GAUTIERI Van Heurck

Gomphonema augur Ehr. var. *Gautieri* Van Heurck, Fr. Hustedt, Bacillar (1930) 372. fig. 689

Valve clavate with broad upper part and apiculate apex End narrow Length, 0.054 mm, breadth 0.013. Reported from Kizaki Lake

GOMPHONEMA LANCEOLATUM Ehr. var. INSIGNIS Gregory Cleve. Plate 4. fig. 4

Gomphonema lanceolatum Ehr var *insignis* (Gregory, Cleve, Fr Hustedt, Bacillar. (1930) 376, fig. 701

Valve lanceolate with attenuate ends Length, 0.042 to 0.04[illegible] mm breadth 0.007 to 0.009 Striæ 10 in 0.01 mm Isolated punctæ distinct Reported from Kizaki Lake. Common in Biwa Lake.

GOMPHONEMA VASTUM Hust. var ELONGATA Skvortzow Plate 2 fig. 17

Gomphonema vastum Hust var *elongata* Skvortzow Diatoms Kizaki Lake 1936 p 13, figs 38, 40.

Valve elongate-lanceolate-linear with obtuse ends Length 0.042 mm, breadth, 0.005 to 0.006. Striæ marginal, 8 to 9 in 0.01 mm. Isolated punctæ distinct. Differs from the type in its elongate valve. Not common Known from Kizaki Lake.

GOMPHONEMA VASTUM Hust. var. MAXIMA var. nov. Plate 2 fig. 7

Larger than the type Length 0.062 mm breadth. 0.008. Striæ marginal, 15 in 0.01 Uncommon.

GOMPHONEMA LANCEOLATUM Hust. Plate 3, fig. 13 Plate 4 fig. 16.

Gomphonema angustatum Hustedt Bacillar aus dem Agerdossee in Japan 166, pl. 5. fig. 5.

Valve clavate. The upper part broadly rounded and abruptly apiculate Lower part attenuate and obtuse Length, 0.018

mm, breadth 0.008 Striæ marginæ, 15 in 0.01 mm Isolated puncta absent. Not common Known from Aokiko and Kizaki Lakes

GOMPHONEMA LINGULATUM Hust. var. ELONGATUM var. nov. Plate 3, fig. 1.

Valve elongate, slightly biconstricted enlarged in the upper part, with apiculate apex. Length, 0.049 mm, breadth, 0.01 Striæ marginal, 13 to 14 in 0.01 mm. No isolated puncta. Not common

GOMPHONEMA LINGULATUM Hust. var. PUMILA var. nov. Plate 3, fig. 19.

Valve minute, rounded at apex, attenuate at the end. Length, 0.01 mm, breadth, 0.005. Striæ marginal, 15 in 0.01 mm No isolated puncta. Differs from the type in its rounded apex and small size. Not common

EPITHEMIA ZEBRA (Ehr.) Kütz. var. PORCELLUS (Kütz.) Grun.

Epithemia zebra (Ehr.) Kütz. var. *porcellus* (Kutz.) Grun. Fr. Hustedt Bacillar. (1930) 385, fig. 731

Valve slightly curved, on the ventral side almost straight, on the dorsal side undulate with rostrate-truncate ends. Length, 0.051 mm, breadth, 0.008. The type is known from Aokiko Lake.

EPITHEMIA ZEBRA Ehr.) Kütz. var. SAXONICA Kütz. Grun.

Epithemia zebra Ehr., Kutz. var. *saxonica* Kütz.) Grun., Fr. Hustedt Bacillar (1930) 385, fig. 730.

Valve geniflexed with attenuate, subrostrate ends. Length, 0.025 to 0.037 mm, breadth, 0.0065 to 0.007 Costæ 3 to 4, striæ 13 to 14, in 0.01 mm. Common Known from Kizaki Lake.

EPITHEMIA TURGIDA (Ehr.) Kütz. Plate 3, fig. 16

Epithemia turgida (Ehr. Kütz. A. Schmidt Atlas D. atom. (1904) p. 250. figs. 5. 6.

Valve robust, broad, with short rounded ends. Length 0.056 to 0.093 mm, breadth 0.014 to 0.017 Costæ 3 in 0.01 mm. Common Known from fresh water

EPITHEMIA SOREX Kütz.

Epithemia sorex Kütz. Fr. Jüstedt Bacillar. (1930) 388, fig. 736.

Valve geniflexed, attenuate towards the capitate ends. Length, 0.017 mm, breadth, 0.0035. Reported from Aokiko and Kizaki Lakes.

EPITHEMIA SOREX Kütz. var GRACILIS Hust. Plate 7 fig. 1

Epithemia sorex Kutz. var. *gracilis* HUSTEDT Bacillar. 1930, 388, fig. 737

Valve curved, gradually attenuate towards the rounded ends. Length, 0.034 mm., breadth 0.0055. Costæ 4, striæ 15, in 0.01 mm. Not common.

EPITHEMIA HYNDMANI W. Smith.

Epithemia Hyndmanii W. Smith. FR. HUSTEDT. Bacillar. (1930) 387, fig. 735.

Valve robust, lunate with elongate and obtuse ends. Length, 0.195 mm., breadth, 0.023. Costæ 3 in 0.01 mm. Common. Known from fresh water.

RHOPALODIA PARALLELA Grun. O. Müll.

Rhopalodia parallela Grun. O. Müll. FR. HUSTEDT. Bacillar. (1930) 389, fig. 739.

Valve linear, slightly reflexed in the middle. Length, 0.08 mm., breadth 0.02. Common. Known from Kizaki Lake and common in alpine lakes of Europe.

RHOPALODIA GIBBA Ehr. O. Müll.

Rhopalodia gibba Ehr.) O. Müll. FR. HUSTEDT. Bacillar. (1930) 390, fig. 740.

Valve linear, undulate and reflexed in the middle part. Length. 0.017 mm., breadth, 0.01. Striæ 7 in 0.01 mm. Reported from Aokiko and Kizaki Lakes.

RHOPALODIA GIBBA (Ehr.) O. MÜL. var. VENTRICOSA (Ehr.) Grun.

Rhopalodia gibba (Ehr.) O. Müll. var. *ventricosa* (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 391, fig. 741.

Valve broad and short. Length, 0.045 mm., breadth, 0.0068. Common.

HANTZSCHIA AMPHIOXUS (Ehr.) Grun.

Hantzschia amphioxus (Ehr.) Grun., FR. HUSTEDT, Bacillar. (1930) 399, fig. 747.

Valve linear or lanceolate with subrostrate ends. Margin constricted on one side, undulate on the other. Length, 0.032 mm., breadth, 0.006. Uncommon. Reported from Kizaki Lake.

NITZSCHIA TRYBLIONELLA Hantzsch var DEBILIS (Arnott) A. Mayer. Plate 3, fig. 34.

Nitzschia tryblionella Hantzsch var *debilis* (Arnott) A. Mayer Fr. Hustedt, Bacillar. (1930) 400, fig. 759

Valve broad-elliptical with cuneate, rounded ends. Margins parallel. Length, 0.017 mm. breadth, 0.0085. Costæ fine, 11 in 0.12 mm. or 9 in 0.01 mm. Not common. Known from fresh and brackish waters.

NITZSCHIA TRYBLIONELLA Hantzsch var VICTORIÆ Grun. Plate 6, fig. 11.

Nitzschia tryblionella Hantzsch var *victoriæ* Grun., Fr. Hustedt Bacillar. (1930) 399, fig. 758.

Valve elliptical, slightly constricted. Length, 0.047 mm., breadth, 0.015. Costæ robust, 5 in 0.01 mm. Common. A brackish-water diatom.

NITZSCHIA ACUTA Hantzsch. Plate 5, fig. 4.

Nitzschia acuta Hantzsch. Fr. Hustedt Bacillar. (1930) 412, fig. 790.

Valve long linear-lanceolate gradually attenuate towards the ends. Length, 0.103 mm., breadth, 0.0042. Costæ 6 in 0.01 mm. Striæ very fine and indistinct. Not common. A fresh-water species.

NITZSCHIA LORENZIANA Grun. var. SUBTILIS Grun. Plate 5, fig. 1.

Nitzschia Lorenziana Grun. var. *subtilis* Grun., A. Schmidt, Atlas Diatom. (1921) pl. 335, figs. 6–8.

Valve sygmoid-linear, attenuate towards the ends. Length, 0.119 mm., breadth, 0.0051. Costæ 15 in 0.01 mm. Striæ indistinct. Not common. Known from brackish water.

NITZSCHIA PALEA (Kütz.) W. Smith.

Nitzschia palea (Kütz.) W. Smith Fr. Hustedt Bacillar. (1930) 416, fig. 801.

Valve linear-lanceolate with gradually attenuate and slightly capitate ends. Length, 0.0204 mm., breadth, 0.0034. Costæ 15 in 0.01 mm. Striæ very fine, indistinct. Not common. Known from Kizaki Lake.

NITZSCHIA CLAUSII Hantzsch. Plate 7, fig. 10.

Nitzschia Clausii Hantzsch Van Heurck Synopsis (1880–1881) pl. 66, fig. 10.

Valve sigmoid-linear with parallel margins and abruptly attenuate and curved ends. Length, 0.052 mm., breadth, 0.003. Costæ 10 in 0.01 mm. Striæ indistinct. Uncommon. Known from brackish water.

NITZSCHIA INTERRUPTA (Kütz.) Hust

Nitzschia interrupta Rosck. Hustedt Bacillar aus dem Aokikosee in Japan 168.

Valve lanceolate with attenuate and capitate ends. Costae robust, reaching about the middle part of the valve. Length, 0.029 to 0.003 mm; breadth, 0.007. Common. Known from Aokiko and Kizaki Lakes.

NITZSCHIA ACICULARIS W. Smith var. NIPPONICA Skvortzow

Nitzschia acicularis W. Smith var. *nipponica* Skvortzow. Diatoms Kizaki Lake (1936, pl. 13, fig. 7.

Valve hyaline, lanceolate with long beaks. Length, 0.01 mm; breadth, 0.0025. Common. Known from Kizaki Lake.

CYMATOPLEURA SOLEA (Bréb.) W. Smith.

Cymatopleura solea (Bréb.) W. Smith, Fr. Hustedt Bacillar. (1930) 425, fig. 823*a*.

Valve broad-linear, constricted in the middle, enlarged and cuneate at the ends. Length, 0.085 mm., breadth 0.015. Known from Aokiko Lake.

CYMATOPLEURA ELLIPTICA (Bréb.) W. Smith var. CONSTRICTA Grun.

Cymatopleura elliptica Bréb. W. Smith var. *constricta* Grun. Fr. Hustedt Bacillar. (1930) 428, fig. 826.

Valve broad-elliptical, slightly constricted in the middle part and broad-cuneate at the ends. Length, 0.161 mm., breadth, 0.069. Striae 8 in 0.01 mm. Not common.

SURIRELLA BISERIATA Breb.

Surirella biseriata Breb. Fr. Hustedt, Bacillar. (1930) 432, figs. 93 - 332.

Valve linear-elliptical or lanceolate-elliptical with parallel margins and gradually attenuate at the ends. Length, 0.111 mm.; breadth, 0.02. Margina keel forming wings. Costae robust, short, 3 in 0.01 mm., not reaching the pseudoraphe. Common. Reported from Aokiko and Kizaki Lakes.

SURIRELLA ROBUSTA Ehr. var. SPLENDIDA Ehr. Van Heurck

Surirella robusta Ehr. var. *splendida* Ehr. Van Heurck Fr. Hustedt, Bacillar. (1930) 437, figs. 851-852.

Valve elongate-ovate with robust costae and striae. Length, 0.091 to 0.096 mm.; breadth, 0.03. Common. Reported from Aokiko and Kizaki Lakes.

SURIRELLA ROBUSTA Ehr. var. NIPPONICA var. nov. Plate 3, fig. 1.

Valve elliptical with broad ends. Length, 0.086 mm; breadth, 0.034. Costæ robust, 1.5 in 0.01 mm., covered with spines. Differs from the type in its perfect elliptical shape and the presence of spines. Uncommon.

SURIRELLA PANTOCSEKII Meister.

Surirella Pantocsekii MEISTER, Beiträge zur Bacillar. Japans. (1930) 230, pl. 8, figs. 14, 15.

Valve long-linear, gradually constricted in the middle and undulate at the ends. Length, 0.049 mm., breadth, 0.0085. Striæ 15 in 0.01 mm. Uncommon. Known from Tokyo and Kizaki Lake.

SURIRELLA TENERA Greg. var. NIPPONICA var. nov. Plate 4, fig. 8.

Differs from the type in its elongate valve, enlarged in one part, attenuate in another. Length, 0.127 mm., breadth, 0.02. Costæ 10 in 0.01 mm. Uncommon.

SURIRELLA RIWENSIS sp. nov. Plate 1, fig. 5. Plate 2, fig. 4.

Valve long-linear, constricted in the middle and slightly capitate, cuneate at the ends. Length, 0.037 to 0.2 mm., breadth, 0.013 to 0.018 in the middle, 0.022 at the ends. Costæ fine, 5 to 7 in 0.01 mm. A species related to *Surirella Alisovians* Skv., from Hanka Lake, eastern Siberia.

SURIRELLA NIPPONICA Skvortzow. Plate 4, fig. 2.

Surirella nipponica SKVORTZOW, Diatoms Kizaki Lake (1936) pl. 8, fig. 17.

Valve lanceolate-elliptical, undulate in the middle, gradually attenuate at the ends. Length, 0.124 mm., breadth, 0.018. Costæ reaching the pseudoraphe. Marginal keel forming wings, or alæ, 2 in 0.01 mm. Striæ distinct, 24 in 0.01 mm. Very common. Known from Kizaki Lake.

SURIRELLA ELEGANS Ehr.

Surirella elegans Ehr., FR. HUSTEDT Bacillar. (1930) 440, fig. 868.

Valve elongate-ovate. Length, 0.144 mm.; breadth, 0.038. Common.

SURIRELLA ELEGANS Ehr. var. NORVEGICA (Eulenst.) Brun. fo. OBTUSA A. Mayer. Plate 1, fig. 5.

Surirella elegans Ehr. var. *norvegica* (Eulenst.) Brun. fo. *obtusa* A. MAYER, Bacillar. d. Regensburger Gewässer (1931) 344, pl. 23, fig. 1.

Valve linear-elliptical with rounded and obtuse ends. Length, 0.235 mm., breadth, 0.037. Costæ 2, striæ 40, in 0.01 mm. Common. Known from Europe.

SURIRELLA GRACILIS (W Smith) Grun fo CURVATA fo nov Plate 9 fig 19

Valve linear-elliptical irregularly curved. Length 0 045 mm breadth, 0.006. Costæ 8, striæ 24, in 0.01 mm Uncommon

SURIRELLA LINEARIS W Smith var CONSTRICTA (Ehr Grun.

Surirella linearis W Smith var *constricta* (Ehr Grun FR. HUSTEDT Bacillar. (1930) 434, fig 889

Valve elliptical constricted, attenuate at the ends. Length 0 057 mm , breadth, 0.01. Common Reported from Aokiko and Kizaki Lakes

SURIRELLA OVATA Kütz. Plate 4, fig 7.

Surirella ovata Kütz., FR. HUSTEDT Bacillar (1930) 442. fig 864

Valve elongate-ovate, broad at one end and attenuate at the other Length, 0 0 7 to 0.024 mm breadth. 0 0068 to 0.0085. Costæ 4 to 8 in 0 01 mm. Common Known from fresh and brackish water

SURIRELLA OVATA Kütz. var PINNATA (W Smith) Plate 2 fig. 16.

Surirella ovata Kütz var *pinnata* (W Smith FR Hustedt, Bacillar (1930) 442, fig 864

Valve linear-ovate with attenuate ends. Length, 0.035 mm, breadth, 0 0052 Costæ 7, striæ 18, in 0 01 mm. Common.

ILLUSTRATIONS

Plate 1

Figs 1 and 2 *Melosira solida* Eulenstein var *nipponica* var nov
3 to 6 *Melosira solida* Eulenstein
Fig 7 *Melosira granulata* (Ehr) Ralfs var *angustissima* O Müll
Figs. 8 and 9 *Stephanodiscus carconensis* Grun var *pusilla* Grun.
Fig 10 *Melosira solida* Eulenstein.
Figs. 11 to 13 *Stephanodiscus carconensis* Grun. var *pusilla* Grun.
Fig 14 *Stephanodiscus carconensis* Grun. var. *pusilla* Grun.?
15. *Cyclotella glomerata* Bachmann fo *nipponica* Skv
16. *Melosira arenaria* Kutz fo. *nipponica* fo. nov
17. *Melosira solida* Eulenstein
18. *Stephanodiscus carconensis* Grun var *pusilla* Grun.
19. *Stephanodiscus carconensis* Grun
20. *Melosira granulata* (Ehr) Ralfs? var *subsalsa* (Meister) Bethge?
21. *Melosira solida* Eulenstein var *nipponica* var nov
22. *Cyclotella comta* (Ehr) Kütz var *oligactis* (Ehr) Grun.
23. *Stephanodiscus carconensis* Grun.
24. *Melosira solida* Eulenstein.
25. *Synedra minuscula* Grun var *capitata* var nov
26. *Coccinodiscus lacustris* Grun var *nipponica* var nov
Figs 27 and 28. *Stephanodiscus biwensis* sp. nov

Plate 2

Fig. *Navicula scutelloides* W Sm
2. *Navicula radiosa* Kütz fo. *nipponica* fo. nov
3. *Achnanthes Clevei* Grun
4. *Synedra acus* Kutz
5. *Surirella biwensis* sp nov
6. *Pinnularia gibba* Ehr var *biwensis* var nov.
7. *Caloneis nipponica* sp. nov
8. *Cymbella turgidula* Grun var *nipponica* var nov
9. *Caloneis bacillum* (Grun.) Mereschk. var *lancettula* (Schulz.) Hust
10. *Navicula subhamulata* Grun.
11. *Epithemia sorex* Kutz var *gracilis* Hust
12. *Neidium obtugestratum* A S.
13. *Gomphonema parvulum* (Kütz.) Grun var *exilissima* Grun
14. *Rhoicosphenia curvata* (Kutz.) Grun.
15. *Eunotia sudetica* (O. Müll.) Hust. var *nipponica* var nov
16. *Synedra ulna* Nitzsch Ehr var *oxyrhynchus* (Kutz) Van Heurck fo. *constricta* Hust.
17. *Gomphonema vastum* Hust var *elongata* Skv.

FIG 18 *Navicula lanceolata* (Agardh) Kutz var *nipponica* var nov
19. *Gomphonema lingulatum* Hust. var *pumila* var nov.
20 *Pinnularia Brauni* (Grun.) Cleve var *amphicephala* (A Mayer) Hust fo. *nipponica* fo. nov
21 *Synedra parasitica* W Smith.
22 *Navicula diecphaca* (Ehr.) W Smith var *neglecta* (Krasske) Cleve
23. *Diploneis ovalis* (Hilse) Cleve var *oblongella* Naeg) Cleve fo. *nipponica* fo nov
24 *Nitzschia tryblionella* Hantzsch var *debilis* (Arnott) A Mayer

PLATE 3

FIG 1. *Diploneis ovalis* (Hilse Cleve var *bipunctata* var nov
2 *Navicula similis* Krasske var *nipponica* var nov
3. *Navicula falaisiensis* Grun. var *nipponica* Skv
4. *Cyrtogma Spencerii* (W Smith) Cleve var *modifera* Grun
5. *Surirella elegans* Ehr var *norvegica* (Eulenst.) Grun. fo *obtusa* A Mayer
6. *Cymbella laca* Grun. var *nipponica* var nov
7 *Synedra rumpens* Kütz var *fragilarioides* Grun. fo. *nipponica* fo. nov
8. *Pinnularia nipponica* Skv.
9 *Caloneis nipponica* sp. nov
10 *Epithemia turgida* (Ehr , Kütz
11. *Gomphonema lingulatum* Hust. var *elongatum* var nov
12. *Gomphonema intricatum* Kütz var *pumila* Grun
13. *Gomphonema lingulatum* Hust
14. *Navicula rostellata* Kutz. var *baccata* var nov
15 *Nerdum duplex* (Ehr) Cleve fo *constricta* Hust
16. *Surirella ovata* Kütz. var *punctata* (W Smith)
17. *Navicula minuta* sp. nov
18. *Caloneis picta* a sp. nov
19. *Surirella gracilis* (W Smith) Grun fo. *curvata* fo nov
20 *Navicula radiosa* Kütz. fo. *nipponica* fo nov

PLATE 4

FIG. 1 *Surirella tenera* Greg var *nipponica* var nov
2 *Navicula undulata* sp. nov
3. *Diploneis marginestriata* Hust var *nipponica* var nov
4. *Cymbella turgidula* Grun var *nipponica* var nov
5. *Surirella nipponica* Skv
6 *Gomphonema lanceolatum* Ehr var *insigne* (Greg.) Cleve
7. *Navicula mutisensis* Schum
8. *Navicula peregrina* (Ehr) Kütz var *nipponica* var nov
9. *Navicula tuscula* Ehr Grun var *dense striata* var nov
10. *Navicula muralis* Kütz. ar *nipponica* var nov
11 *Diploneis ovalis* (Hilse) Cleve var *Nipponica* var nov.
12 *Pinnularia undulata* Greg var. *nipponica* var nov.
13. *Synedra nipponica* Skv
14. *Frustulia rhomboides* (Ehr) de Toni var *saxonica* (Rabh.) de Toni fo *nipponica* fo nov

FIG. 15. *Caloneis nipponica* sp. nov
16. *Cocconeis diaphana* Schum. var *nipponica* var. nov
17. *Surirella ovata* Kütz

PLATE 5

FIG. 1. *Surirella robusta* Ehr var. *nipponica* var nov
2. *Pinnularia gibba* Ehr
3. *Pinnularia Brauni* (Grun.) Cleve var *nipponica* var nov
4. *Nitzschia acuta* Hantzsch.
5. *Achnanthes Clevei* Grun var *nipponica* Skv
6. *Pinnularia streptula* sp. nov
7. *Stauroneis Smithii* Grun var *rhombica* Meister
8. *Navicula scopulorum* Krasske
9. *Nitzschia Lorenziana* Grun. var *subtilis* Grun.
10. *Navicula Kawamuræ* sp. nov
11. *Navicula subhamulata* Grun var *parallela* var nov
12. *Navicula contenta* Grun. var *nipponica* var nov
13. *Navicula contenta* Grun. fo. *curta* fo. nov
14. *Achnanthes Brasiliensis* Kütz
15. *Attheya Zachariasi* Brun
16. *Navicula costata a* Grun. var *tenuirostris* var nov
17. *Navicula Nippon* sp. nov.
18. *Achnanthes affinis* Grun.
19. *Diploneis ovalis* (Hilse) Cleve var *oblongella* (Naegeli) Cleve.
20. *Cymbella nipponica* sp. nov
21. *Synedra nana* Meister var *nipponica* Skv
22. *Gomphonema Bergianum* Cleve
23. *Cymbella nipponica* sp. nov

PLATE 6

FIG. 1. *Coscinodiscus lacustris* Grun var *nipponica* var nov
2. *Stephanodiscus carconensis* Grun. Anomaly.
3. *Pinnularia polyonca* (Breb.) O. Müll. var *nipponica* var nov
FIGS. 4 and 5. *Epithemia onegensis* Wisl. and Kolbe.
FIG. 6. *Fragilaria vulpina* Thwaites var *asiatica* Skv
7. *Amphora ovalis* Kütz. var *libyca* (Ehr.) Cleve
8. *Pinnularia Lacus Buwa* sp. nov
9. *Caloneis silicula* Ehr var *baicalensis* Skv. and Mayer
10. *Pinnularia viridis* (Nitzsch) Ehr var. *leptogongyla* (Ehr ? Grun.) Cleve.
11. *Nitzschia tryblionella* Hantz var *victoriæ* Grun.
12. *Achnanthes Hauckiana* Grun var. *nipponica* var nov
13. *Navicula menisculus* Schum
14. *Synedra Ulna* (Nitzsch) Ehr var *Remes* (Herib. and Peragallo) Hust
15. *Navicula Lambda* Cleve var *nipponica* var nov
16. *Gomphonema longiceps* var *subclavatum* Hust.

PLATE 7

FIG. 1. *Gyrosigma acuminatum* Kütz. Rabh. var *nipponica* var nov
2. *Rhoicosphenia curvata* (Kütz.) Grun. var. *major* Cleve

FIG. 3. *Pinnularia platycephala* Cleve var *Hattoriana* Meister fo. *angustior* fo. nov.
4. *Surirella ovalis* sp. nov.
5. *Navicula lanceolata* (Agardh) Kütz. var *nipponica* var. nov.
6. *Navicula undulata* sp. nov.
7. *Navicula placentula* Ehr. Grun.
8. *Navicula schizonetioides* sp. nov.
9. *Navicula ambigua* Pant. var. *gracilis* var. nov.
10. *Nitzschia Closterium* Hantzsch.
11. *Caloneis bacillum* (Grun.) Mereschk. var. *lanceolata* (Schulz) Hust. fo. *denticulata* fo. nov.
12. *Pinnularia viridis Nannacularis* sp. nov.

PLATE 8

FIG. 1. *Neidium obliquestriatum* A. S. var. *longata* var. nov.
2. *Pinnularia undulata* Greg. var. *nipponica* var. nov.
3. *Pinnularia cuneata* sp. nov.
4. *Pinnularia Nakai* sp. nov.
5. *Pinnularia nipponica* Skv.
6. *Pinnularia microstauron* (Ehr.) Cleve var. *nipponica* var. nov.
7. *Gomphonema insigne* Hust. var. *maximum* var. nov.
8. *Navicula gastrum* Ehr. fo. *nipponica* fo. nov.
9. *Navicula cruciculoides* (W. Smith) Donk. var. *obtusata* Grun.
10. *Didymosphenia geminata* (Lyngb.) M. Schmidt.
11. *Pinnularia viridis* (Nitzsch) Ehr. var. *fallax* Cleve.
12. *Eunotia gracilis* (Ehr.) Rabh.
13. *Eunotia praerupta* Ehr. var. *bidens* Grun.

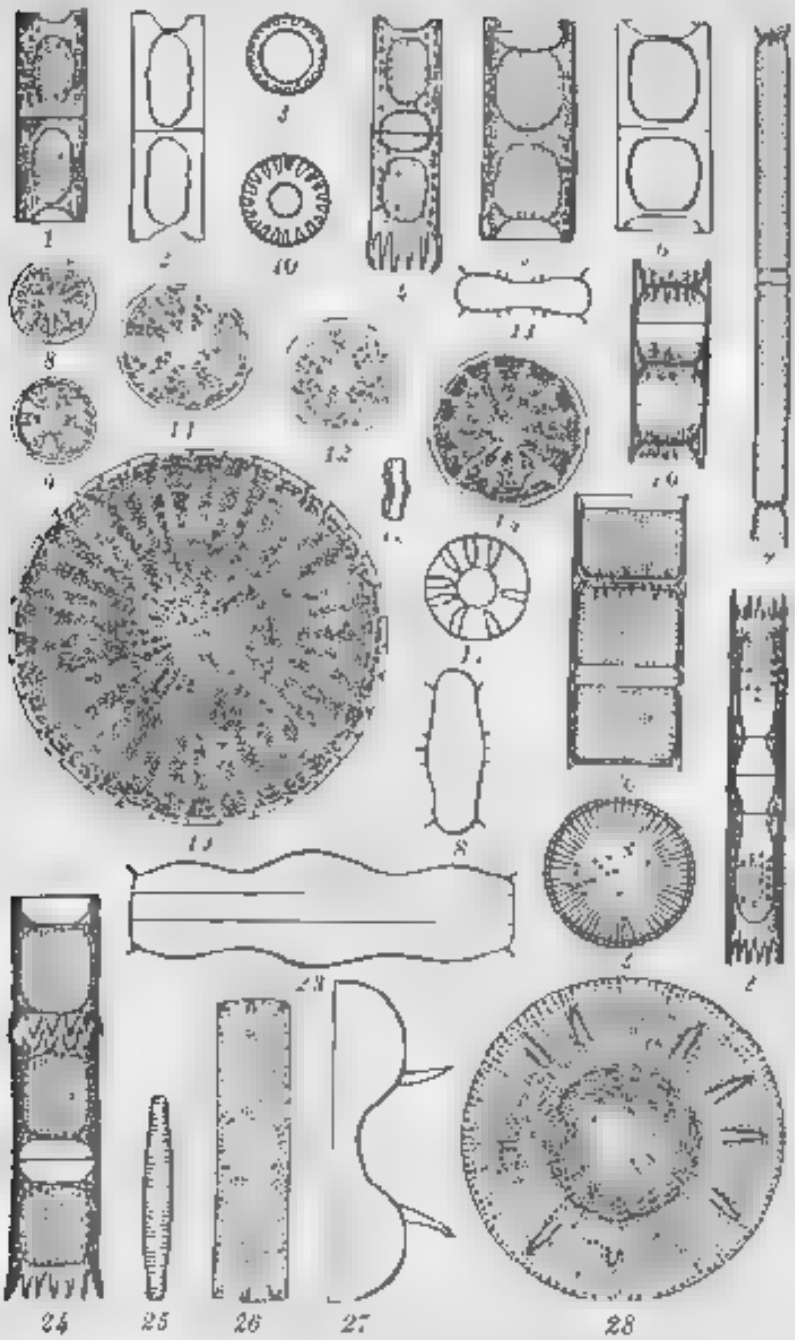
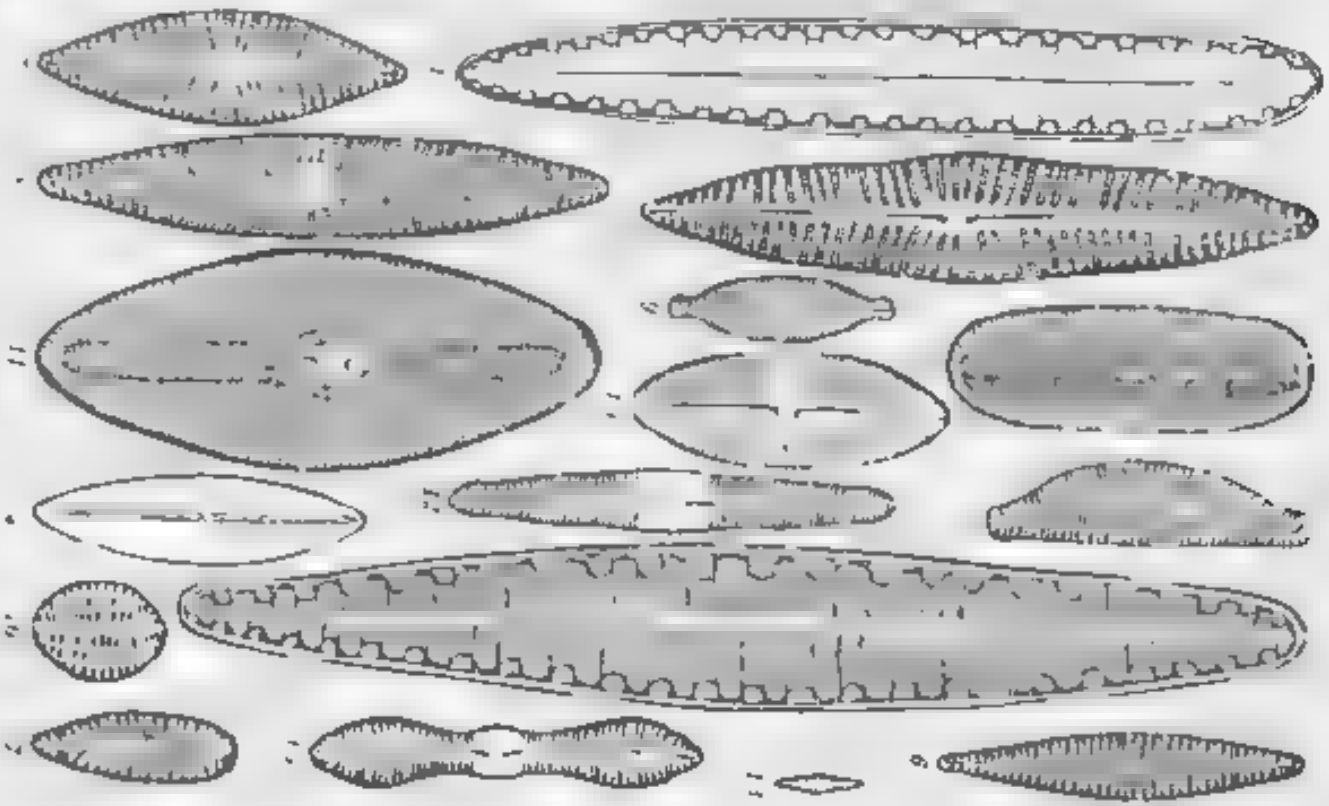


PLATE 1

PLATE 7

PLATE 3



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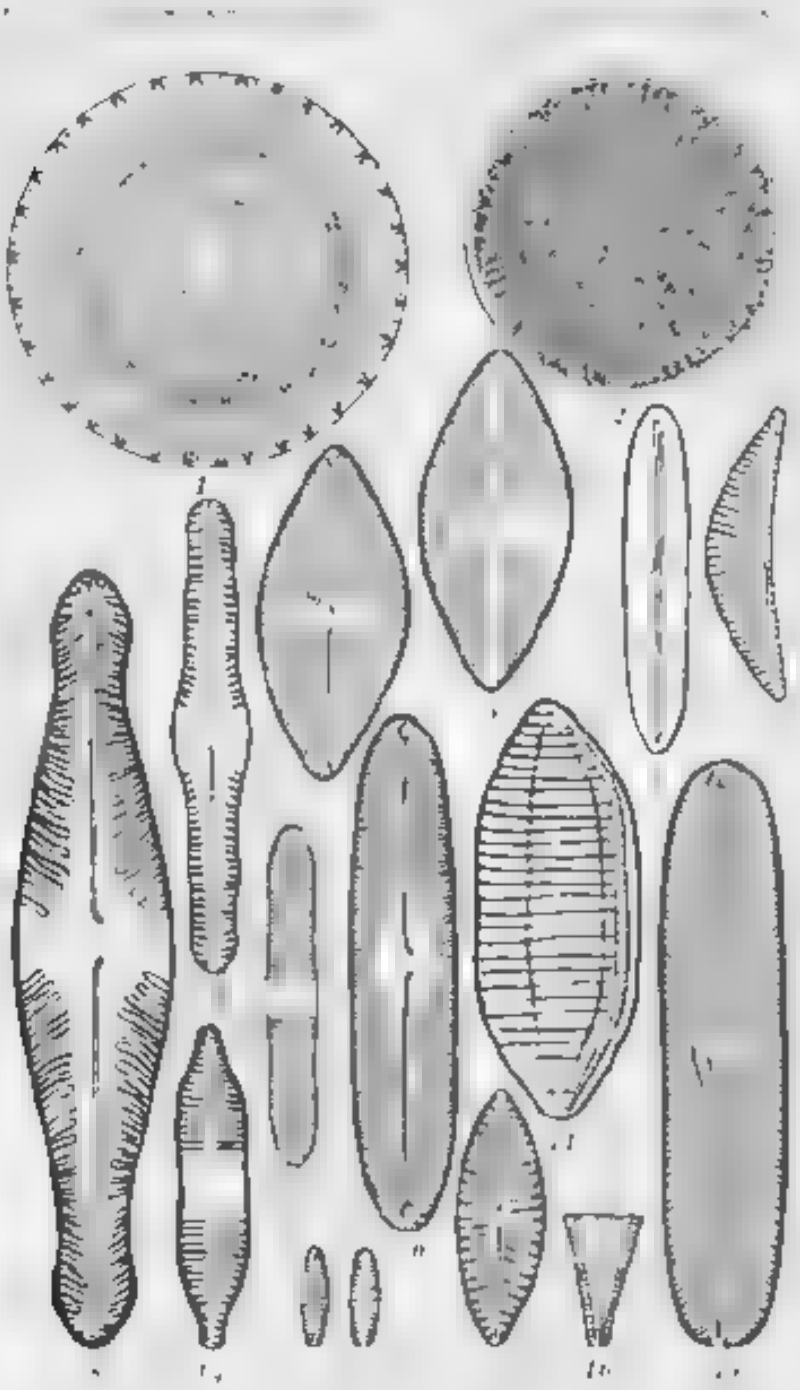

PLATE 9

PLATE 7

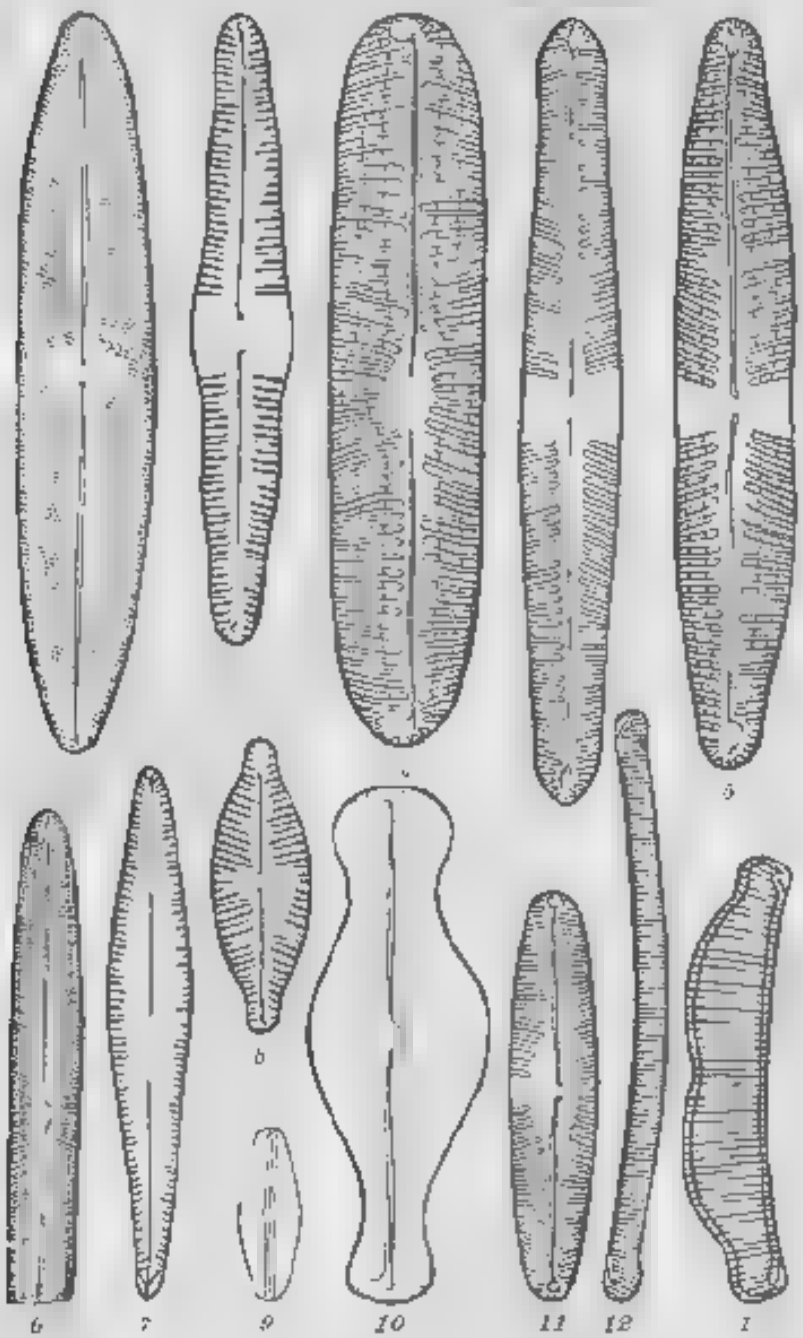

PLATE 8.

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review

RECEIVED

American society for testing materials. Committee D-13 on textile materials. A. S. T. M. standards on textile materials. Philadelphia, Pa., 1935. 246 pp., illus. Price, paper, $1.50.

ANDREWS, ANDREW I. Enamels: the preparation, application, and properties of vitreous enamels. 1st ed. Champaign, Ill. The Twin city printing co., 1935. xv + 420 pp., illus. Price, $5.50.

BAKER, JOHN R. Cytological technique. London, Methuen & co., 1933. xi + 131 pp., illus.

BROMLEY, DOROTHY DUNBAR. Birth control: its use and misuse. With an introduction by Robert Latou Dickinson. New York and London: Harper & brothers, 1934. xxii + 304 pp. Price, $2.50.

BUEHLER, E. C., comp. and ed. Free medical care: socialized medicine. New York: Noble & Noble, 1935. Price $2.

DEMPWOLFF, OTTO. Vergleichende lautlehre des austronesischen wortschatzes. I. Berlin: Reimer, 1934. (Zeitschrift für eingeborenensprachen. Beihefte 15.) 184 pp. Price, $3.25.

DUGDALE, J. N. Health in hot climates. 2d ed. London, John Bale sons & Danielsson, 1933. 289 pp. Price, $4.25.

GHOSH, DIRENDRA NATH. A treatise on hygiene and public health with special reference to the tropics. New and largely rewritten with the assistance of A. D. Stewart. 8th ed. Calcutta, Scientific publishing co., 1935. xv + 660 pp., illus. Price, $3.25.

GRAYBARD, MARK. Genetics and the social order. New York city, Tomorrow publishers, 1935. 127 pp. 4 charts. Price, paper $0.50, cloth, $0.75.

HESS, FRED H., ed. 1000 questions and answers on T. B. New York, Journal of the outdoor life, 1935. vi + 232 pp. Price, $0.75.

HOTTES, ALFRED CARL. 600 Garden questions answered. New York, A. T. De La Mare company, 1935. ix + 329 pp., illus. Price, $2.

HOWARD, LOUISE E. Labour in agriculture: an international survey. London, Oxford university press, 1935. xv + 439 pp. Price, $7.

LLICK, JOSEPH S. An outline of general forestry. N. Y. Barnes & Noble [c. 1935] 250 pp. Illus. Price, $1.50.

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SIEGEL, MORRIS. Constructive eugenics and rational marriage Toronto, McClelland & Stewart [c 1934] xii + 196 pp. illus.

SMALL, VICTOR R I knew 3000 knaves New York, Farrar & Rinehart [c 1935] viii + 273 pp. Price $2.50.

SMITH, JAMES GERALD. Economic planning and the tariff an essay on social philosophy. Princeton Princeton university press, 1934. x + 331 pp. Price, $3

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Union of Soviet Socialist Republics State planning commission of the council of peoples commissars. Summary of the fulfillment of the first five-year plan for the development of the national economy of the U. S. S. R Report 2d rev. ed. New York International publishers, 1933 264 pp. Price, $1.25

REVIEWS

Garden Flowers in Color, a Pictured Cyclopedia of Flowers. By Glendon A. Stevens. The Macmillan Company, New York, 1934. 320 pp., col. illus. Price $3.75

This is a unique book on ornamentals. The author acknowledges that it has been written for the most part from actual garden acquaintance with the wide range of flowers described * * * He claims that in so doing his purpose is to provide "a book of definite educational value as well as a convenient garden adjunct." To see how far in each case the book meets his expectations, one needs only to glance at the assembly of over 300 garden flowers illustrated with much fidelity in their natural colors with beautiful photographic plates. These illustrations, which are enough to make one welcome the book, will show many an inexperienced gardener just what most garden blooms look like. Each illustration is accompanied by a brief account of the habits of the plants, their use, and cultivation. This is an added feature which makes the book doubly useful as a dependable guide to garden flowers. The descriptions are brief and include the scientific names of the flowers.

The arrangement is alphabetical but individual plants are better located by consulting the index.—E. G.

Economic Geography of Asia. By Daniel R. Bergsmark. Prentice-Hall Inc., New York, 1935. 418 pp., illus. diagrs. maps. Price, $5.

While a few good books on Asia have already been published, Bergsmark's textbook meets ideally the average requirements of a college textbook on Asia. He is always on the alert, examining the mutual relationships which may be established between man's manifold activities in his effort to earn his living and the natural environmental complex, thus eliminating unessentials and irrelevant subject matter.

The illustrations, graphs, diagrams, and maps are illuminating, but there are many typographical errors a few of which are the following: Page 24, Red Sea, page 72, 5th and 10th lines, of of, page 114 autonomous states page 210 last line of 3rd paragraph, the the, page 424, coking coal page 427, potassium sodium

There are some statements which need to be corrected or improved, such as that on page 27, "In the Philippines, thousands of miles of terraces extend throughout various parts of the ar-

chipelago." Such terraces are only found in the Mountain Province, Luzon, and not throughout the various parts of the Archipelago. On page 69, "While Asia adds but little to the total amounts of coal and iron ore of the commercial world it does contribute large percentages of the world's tin, antimony, tungsten, graphite and emory." Why not just also copper and gold? Japan is one of the ranking copper producers and so are Manchukuo, Chosen, Taiwan, China, and the Philippines for gold.

The inclusion of Cultural, Religious, and Linguistic Diversity on page 179 under chapter XI the Natural Environment of India, may lead an unwary student to an erroneous concept of natural environment.

On page 347, "Rice , and the highest yields per acre are obtained in the Candaba Swamp ." The Candaba Swamp proper does not produce rice. It is a reserved area for wild life such as birds and fishes. The immediate surrounding land which may have been reclaimed from the original swampy area certainly is not the highest yielder of rice per unit area, but Nueva Ecija, a province in Central Luzon.

Notwithstanding these minor observations, the reviewer considers Bergamark's Economic Geography of Asia as interestingly readable to the layman, well suited to college students pursuing a course on Asia; and thought-provoking to teachers, well worth the price of the book.—C. C. C.

Marine Boring Animals Injurious to Submerged Structures. By W. T. Calman. Second edition rev. by G. I. Crawford. British Museum (Natural History) Economic Series No. 10. The British Museum, London, 1936. 38 pp., 1 pl. Price, $0.25.

This pamphlet is a valuable contribution on the subject of marine boring animals and the destructive effect they may have on submerged structures. It sums up our present-day knowledge of the natural history of the animals concerned and offers significant details which are useful both to zoölogists and to marine engineers who are interested in the practical application of the facts recorded.

The pamphlet is well illustrated. A list of the most important titles is given to provide guidance for those who wish to pursue the subject further.—F. T.

Wistar Institute Style Brief. Prepared by the cooperative efforts of the editors of journals published by the Wistar Institute and the staff of the Wistar Institute Press. The Wistar Institute Press, Philadelphia, 1924. 100 pp. illus., plates. Price $2.

This handbook is a concise answer to the long felt need for a style guide especially designed to meet the peculiar needs of the technical and scientific writer. Principles that wise writers and editors have evolved laboriously for themselves from experience and continual groping after what is common sense, are here laid down in simple and direct form, so as to be available to the consultant at a moment's notice.

While the purpose of this little book is largely to explain Wistar Institute methods to biological writers and to promote cooperation between author and editor, it cannot fail to be extremely welcomed by those concerned in the writing and publication of scientific and technical papers in general, as the suggestions it contains, except as pertaining to matters of practice with regard to which even the best printing offices are at variance, apply to technical writing in any field.

Writers of scientific papers who hitherto felt that there is a definite technique to be acquired about the preparation of papers for publication, have had to rely on books of such general scope as the Style Manual of the United States Printing Office, and other treatises from books that do have great practical utility and go into some detail in specific fields, but are inadequate as desk reference books on the many troublesome problems confronting the technical writer. The Wistar Institute style book, though not as detailed, offsets these shortcomings of the general desk book and can be used with equal profit either as a supplementary reference guide or independently.

One gratefully notices that, as far as scientific papers are concerned, the authors have regarded no problem as too trivial or too complex to come within the scope of the book. Choice of paper, margins, and pagination are given as definite treatment as reference lists and the most suitable methods of preparing illustrations under different technical and financial conditions.

Intelligent use of this style brief will save the author considerable misdirected effort over the matured author will find

it a profitable means of clarifying and confirming rules that he has built up in the course of time out of his own experience. The new author will find the brief, direct discussion of what constitutes a well-prepared technical paper invaluable.—S. R.

Electrons (+ and −) Protons, Photons, Neutrons, and Cosmic Rays. By Robert A. Millikan. (The University of Chicago Science Series.) The University of Chicago Press, Chicago, Illinois, 1935. 491 pp., illus. Price, $3.50.

This volume is the answer to the scientist's prayer for a clearer conception of modern physics, in which the author, whose works are widely used not only in America but also in other countries, presents some of the newer developments in the field with which he has closely associated his own work. These are the recent researches on the wave nature of the electron, the spinning electron, the positron, the neutron, transmutation of the elements and cosmic rays. Although by weaving the discussion around these subjects the author makes the book interesting, the general reader will find certain chapters the understanding of which requires more than a background of physics. Except for this requirement, any reader with scanty technical training may still get a lot of valuable information on the fascinating progress of modern physics described in this book.—J. C. E.

Reproduction, Heredity and the Development of Sex. By H. G. Wells, Julian Huxley (and) G. P. Wells. Cassell & Company, Ltd., London etc. 1935. 228 pp., 40 figs. Price, $2.

This small volume is the fourth in "The Science of Life" series, somewhat enlarged and brought up to date. Beginning with a discussion of the primitive types of reproduction which may be considered a special type of growth accompanied by detachment of daughter organisms, the authors arrive at the conclusion that sex is not reproductive. Sex is essentially antireproductive, inasmuch as the daughter organisms are not, so to say, chips of the old block, but the result of the interaction of the germinal substances carried by the sex cells from the two parents, who contribute equal amounts of the hereditary material. In this fact lies the means by which variations are reshuffled and recombined among the members of the species. How these variations are transmitted to the offspring is considered in a chapter in which the high lights of genetic knowledge are discussed. An attempt is also made to correlate genetics with embryology, but the result is vague due mainly to the

paucity of data along this line. Finally the authors give a summary of the chromosome theory of sex determination. No bibliography is included, but a good index is given. A. B.

Practical Infra-Red Photography. By Othmar Helwich. A translation by J. L. Boring from the German of "Die Infrarot-Fotografie." The Fountain Press, 19 Cursitor Street, E. C. 4, London. [No date] 98pp. Price, $1.

Infra-red photography is a phase of photographic technic that has been developed within the last few years. In this book Othmar Helwich outlines its essential principles and describes its possible applications in various fields.

Nowhere is the infra-red plate more useful than in scientific photography, and the author bares its special adaptability in medicine, astronomy, criminology, and photomicrography. That it is also useful in photographing old documents, reproducing faded manuscripts, and testing fabrics is likewise shown by him.

Insofar as it instructs the amateur as well as the professional photographer and the scientist regarding the nature of infra-red photography, this book is valuable.—C. S. A.

Oxygen and Carbon Dioxide Therapy. By Argyll Campbell and E. P. Poulton. Foreword by Sir Leonard Hill. Oxford University Press, Humphrey Milford, London. 1934. 179 pp. 98us. Price, 12s. 6d.

The mass of information scattered in scientific literature and the results of the extensive research and clinical observations of the authors are combined to form the basis of the present book.

Oxygen therapy has now become the established treatment for pneumonia and other pulmonary conditions, certain cases of cardiac failure, and carbon monoxide poisoning. For efficient treatment of these conditions a suitable apparatus is necessary. In this book the authors describe fully the different methods of giving oxygen treatment efficiently. A breathing mask or an intranasal tube may be used, or the patient be put in an oxygen chamber or oxygen tent. For this purpose the use of such apparatus as Bragg's and Draiker's for giving continuous respiration is described.

The treatise is divided into nine chapters, at the end of which is a summary, for the sake of readers who may not have the time to weigh the whole of the evidence. It is also supplied with an adequate bibliography.

To practitioners and hospital directors, especially in the Philippines where the old rectal method of administration is still in vogue, in order to give them an insight of the modern methods of oxygen administration, this book is recommended.—I. C.

Human Sterilization Today, a Survey of the Present Position. By Cara B. K. Hudson. Watts & Co. London 1934. 55 pp. Price $0.50

One drawback to the book is the small print, which makes it difficult to read. However, it is an interesting collation of the scientific and experimental work on sterilization hitherto done in America and Europe. It presents beneficial results which should be wisely considered by all economists, eugenists, and political and social workers, as well as by officials of penal and psychopathic institutions. The application of sterilization in the Philippines as a means of improving the race and as a preventive measure in limiting hereditary mental, and physical disabilities should be food for serious thought among progressive thinking Filipinos. U. D. M.

Applied Silviculture in the United States. By R. H. Westveld. Edwards Bros. Inc., Ann Arbor, Michigan 1935. 414 pp., illus.

This publication on regional silviculture in the United States brings together the results of various studies made by the author, the Forest Service, experiment stations, and forest schools. Eighteen forest regions, eight in the western, nine in the eastern part of the United States, and one in Alaska, are thoroughly discussed under the main headings of Description, Historical Ecological Basis for Silvicultural Practice, Economic Basis for Silviculture Practice and the Application of Silviculture. Each chapter has been submitted for review to one or more authorities in the region to which the chapter applies so that the book may be considered authoritative. The book gives the reader a good idea of the physical and economic limitations, the present condition, and the modifications or improvements that must be developed in each of the forest regions.

The book is lithoprinted in two-column style and is well illustrated with photographs. There is a list of references at the end of each chapter and an index to the whole book. An appendix gives the common and scientific names of trees. C. S.

Sex Behavior in Marriage. By Charles A. Clinton. Pioneer Publication, Inc., 1270 Sixth Ave., Radio City, N. Y., 1935. 184 pp. illus. Price $2.

This book is excellent for the layman but rather elementary for the physician. The anatomy and physiology of sex are explained in simple terms. The facts of life are explained to prospective newlyweds in a way to avoid shocking the sensitive. The facts dealing with the psychology of coitus and its proper performance may train prospective mates to avoid various pit-

falls that otherwise might cause marital unhappiness. It will enable parents to safeguard their children from half-truths gleaned furtively from unreliable sources. E. M.

Race Differences. By Otto Klineberg. Harper & Brothers Publishers, New York and London, 1935. 267 pp. Price, $2.50.

This book discusses race differences from three distinct approaches, namely, biological, psychological, and cultural. The author states that there is no racial hierarchy that is consistently supported by all the available evidence, and that the notion that one race is more primitive than another has no acceptable scientific foundation. He also states that he has carefully evaluated the theories on psychological race differences and has found them to have no basis in the study of physical characteristics, endocrine glands, blood or brain, or in tests of sensory capacity, intelligence, or personality, or in the analysis of criminal statistics. He has further analyzed the relation between culture and psychology and has shown that fundamental behavior differences in race groups can be explained on a cultural basis. He concludes "that there is no adequate proof of fundamental race differences in mentality and that those differences which are found are in all probability due to culture and the social environment." This book contains exhaustive material with clear and lucid exposition of facts intended primarily for students and the intelligent layman. Every student interested in ethnology should have a copy of this book. R. E. G.

The Technique of Contraception: an Outline. By E. M. Mastner. Published for the National Medical Council on Birth Control by the Williams & Wilkins Co., Baltimore, 1936. 60 pp. illus. Price, $0.50.

This is a short, concise, and to-the-point manual of practical instruction on the safest and most effective methods of contraception known at present.

In a foreword by Robert L. Dickson, the point is brought out, one that is too often overlooked, that from a standpoint of safeguarding the health of mothers, the whole question of contraception is of public-health significance and properly belongs to the department of preventive medicine.

In the discussion of the technic of contraception the author makes the usual divisions into general measures applicable to the male, measures used by the female, and measures giving prolonged protection such as intra-uterine stem, hormones, and proteins.

Though it is written primarily for the medical profession, there is nothing in the outline that would not be readily understood by an intelligent layman.

Despite its brevity, the book is profusely illustrated by diagrams, showing the precise manner in which vaginal diaphragms and cervical caps should be used. The book is very practical and worth reading by any student interested in the subject.—U. D. M.

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PHILIPPINE CICADELLIDÆ (HOMOPTERA)

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FOUR PLATES

INTRODUCTION

The Nearctic and Palæarctic species of the family Cicadellidæ, which includes many pests of crops, have been well worked. However, the Oriental species, especially those of the Malayan region, have been very little studied. Distant[1] thinks the Cicadellidæ being practically unworked in certain sections of the world may prove to be the most extensive family of the Homoptera.

The description of Philippine species started with miscellaneous collections by early collectors. Most of the specimens described were from the British Museum. Among the early workers were Walker, Stål, and Signoret. Later Melichar, Kirkaldy, Matsumura, Distant, and Baker became prominent as describers of eastern Palæarctic, Oriental, and Australian, as well as Indian, Cicadellidæ. Baker collected and described more Philippine species of this family than all of the other above-mentioned workers together. All of Baker's work on Philippine Cicadellidæ was published in the Philippines. His collection in the United States National Museum is practically untouched.

The nucleus of the present work on Philippine Cicadellidæ was the few specimens that I took from the Islands and material subsequently sent to me, from time to time, by my associates

[1] Fauna Brit. and Rhynch. 3 (1906) 52–54.

in the Bureau of Plant Industry. The collection of Professor Osborn contributed several new species and many interesting old forms. Later my studies were extended to the United States National Museum, primarily for the purpose of comparing my types and determinations with the extensive Baker collection from the Philippine Islands. Several additional forms were studied and are described in this paper.

In general I have followed Distant [2] in the arrangement of these insects. It has been necessary, of course, to include some genera subsequently erected by Baker, Kirkaldy, Matsumura, and others, under divisional groupings according to Distant's synopsis. For structural characteristics and descriptions with reference to the names of sclerites and the wing venation of species, the excellent plates of Edwards [3] and Osborn [4] were consulted and adopted.

In this work I have described or determined eighty-three species, thirty four of which are new, thirty nine are old species of known Philippine distribution, and fourteen are species reported for the first time from the Philippines. In checking Baker's material and comparing it with the original descriptions, nine more species were listed for the Philippines for the first time. With the descriptions of the species I have recorded the distribution, the host plant, and the economic status where such information was available. *Agalla* DeLong and Davidson with a known Australian and Nearctic distribution is here recorded for the first time in the Orient. Four species are described. *Macropsis* was believed to be exclusively Nearctic Palaearctic and Ethiopian in distribution, but nine species of this genus came to light in the Philippine material and are herewith described. *Cicadula* is here first recorded as a Philippine genus.

Two genera are erected, one to receive two species, and the other three. One genus is given a new name. This preoccupied and monotypic genus of Distant,[5] *Alluaudia* now *Allaudula*), receives another species in this paper.

ACKNOWLEDGMENT

The present study of Philippine Cicadellidæ was made possible by the encouragement and unfailing assistance of Prof. Herbert Osborn, of Ohio State University, under whose direction this

[1] Op. cit. 4 (1908).
[2] Homoptera Homoptera of the British Isles. L. Reeves & Co. (1906).
[3] Ohio Biol. Surv. 5 No. 4 (1928).
[4] Fauna Brit. Ind. Rhynch. 4 (1903). Illus. No. 2867.

work was undertaken. He placed at my disposal his collection of Philippine cicadellids and his private library, which contains a wealth of invaluable literature on this group of insects.

My thanks are also due to Mr. P. W. Oman, taxonomist of the order Homoptera in the United States National Museum, for valuable suggestions and help at the museum and for the loan of some specimens from the Baker collections, to Dr. H. L. Morrison, in charge of the insect division of the United States National Museum (now of the Bureau of Entomology and Plant Quarantine), for furnishing me with working space and equipment, to Dr. D. M. DeLong for aid, especially in the genus *Agetus*, to Dr. E. P. Breakey, of the department of zoology and entomology, Ohio State University, for valuable suggestions and criticism during the early part of this work, the reading of the manuscript, and the checking of some of the specimens especially those of the genus *Macropsis*, to my colleague in the Bureau of Plant Industry, Mr. F. Q. Otanes, of Manila, who from time to time sent me specimens collected in various parts of the Islands by the inspectors of the Philippine Bureau of Plant Industry, and above all to Dr. Manuel L. Roxas, who did everything possible to enable me to complete my work.

During the preparation of this paper I was guided by the excellent publications of W. L. Distant, C. F. Baker, and H. Osborn. I have occasionally referred to the works of F. Edwards, D. M. DeLong, and E. P. Van Duzee.

Most of the drawings were made by Mrs. C. W. Taft, some by M. F. B. Whittington under my supervision, and the rest were drawn by myself.

In the preparation of the check list with the original bibliography and synonymy, I am indebted to Baker's unpublished notes for the names of some species and their synonyms.

ECONOMIC IMPORTANCE OF THE CICADELLIDÆ

The Homoptera are of great concern to man. Among them are insects causing extensive injury to plant life. They are mostly of small size, multiply rapidly, and adapt themselves readily to all climatic conditions. Their attack goes unnoticed until the plants have lost so much vitality that they are either stunted or killed. The Cicadellidæ, therefore, are probably the most important family in this group of insects.

Their astounding breeding capacity, their mode of attack, which is to keep themselves always under the leaves of the host plants, together with their small size and protective coloring,

result in large numbers of them not being noticed until the plants attacked are ready to die.

Usually, however, these attacks do not cause the death of the host plants, but only greatly reduced vitality and productivity. For this reason their presence often escapes notice.

Serrano and Palo[1] estimated the loss of mango fruit due to the persistent attack of the mango leaf hoppers *Idioscerus clypealis* and *Chiasmia nitecoparsa* for 1932 in three mango-growing provinces of Luzon to be 75.32 per cent of the crop.

These small insects occur in great numbers and feed especially on the sap of the young growing shoots. When the hoppers are numerous the amount of sap extracted by them is sufficient to prevent growth and to cause the loss of the entire crop of fruits. Lefroy[2] found that *Nephotettix apicalis* and *N. bipunctatus* multiply enormously and are a distinct plague to rice in India. *Cicadella spectra* Distant is another of the cicadellids that is numerous and ranks as a major pest of rice in India. These three species also occur in abundance in the Philippines and are certainly as bad rice pests here as in India.

Empoasca flavescens, the well-known green fly of tea whose distribution is world-wide, is a serious pest in India. This species damages cotton and various solanaceous crops in the Philippines.

LIFE HISTORY

Life-history work in this family is practically untouched. It is a field of considerable interest, as these insects have well-defined habitats and plant hosts and seem to be readily affected by such ecologic factors as temperature, moisture, and natural enemies.

Aside from work on the mango leaf hoppers *Idioscerus clypealis* Lethierry and *Chiasmia nitecoparsa* Lethierry, for whose damages Serrano and Palo[1] proposed the name "blossom-blight of the mango" to distinguish them from the less abundant leaf hoppers found on mango, no life history has ever been attempted on Homoptera in the Philippines.

The cicadellids have multifarious habits. Some are arboreal, some live and breed on herbs and bushes, some on reeds, and many of them feed and breed on old or green pasture grass. Some are solitary, others swarm in great numbers. It is

[1] Philip. Journ. Sc., 50 (1933) 211-277.
[2] Indian Insect Life, Thacker, Spink & Co., London (1909) 738.
[3] Philip. Journ. Sci., 30 (1923) 211-277.

supposed that most of them breed the year round with more or less predominance in certain favorable seasons. Certain species multiply during the dry season, and others appear in great numbers during the rainy season.

The preponderance of a species, however, depends more or less on the abundance of its hosts, and the stage of the host which is succulent to the species concerned. The grass types multiply in great numbers during the rainy season when grasses are growing most vigorously. In the Philippines *Nephotettix apicalis* and *N. bipunctatus* are numerous in the early part of the rainy season, during June when rice is beginning to grow vigorously. *Idioscerus clypealis* and *Chiasmia nitrosparsa* are abundant on forced mangoes in November and December and on mango blossoms during the regular season, that is, from January to April.

GEOGRAPHIC DISTRIBUTION

The cicadellids have well-defined habitats and plant hosts. Their distribution is limited by climatic conditions and the distribution of their host plants.

In the Tropics plant distribution seems to limit the distribution of the species. The mango pests of India are of the same subfamily as those that attack mangoes in the Philippines, the Idioscerinæ. Whether or not the species of *Idioscerus* on the mango in India are distinct from those in the Philippines is questioned. Sugar canes and bananas have specific leaf hopper pests that are more or less widely distributed. Some of the species attacking rice are as widely distributed as the area where rice is the commonest crop. *Nephotettix apicalis* Motschulsky is present from India to Japan, including, of course the countries and islands intervening.

The distribution of cicadellids is limited by land barriers, high mountains, large bodies of water, and climatic conditions. Each faunal region, when not affected by certain agencies of dissemination, has its own fauna characteristics. The Philippine cicadellids are distinctly Indo-Malayan, tinged with certain Palæarctic elements, which were introduced by commerce. It is possible that some Neotropical species are present due to the early importation of plants from Mexico. However, such introductions are doubtful in view of the distance, the slow transportation at the time, and the bringing of seeds mostly instead of living plants. Some leafhoppers from China and Japan may have gained a foothold through constant importations of or

namental plants. Perhaps some are due to a land bridge, which may have existed between continental Asia and some part of the Philippines, or a similar connection between Indo-Malayan regions and Papuan and adjacent islands. Some Australian species have been recorded in the Philippines.

Although the species of *Malleonia* are distinctly Philippine the Idiocerini are most likely of Indian origin. It is difficult to determine the origin of most of these species unless we know their habits and their host plants, as well as the native homes of such hosts. We know that most of the existing species of wide distribution are arboreal. The Tartessusaria Idiocerini, and most of the well-known Typhlocybinæ and Cicadellinæ are arboreal insects, possibly transported by commerce.

SYSTEMATIC RELATIONS OF THE HOMOPTERA AND DIVERSITY OF OPINION CONCERNING THEM

In the classification of Homoptera first consideration was given to the number of the tarsal and antennal joints and the character of the wings. Thus Westwood, according to Distant,[1] divided the Homoptera as follows:

Trimera. Tarsi 3-jointed and antennæ minute; wings areolate.
Dimera. Tarsi 2-jointed and antennæ moderate, 6- to 10-jointed, wings areolate.
Monomera. Tarsi 1-jointed antennæ 6- to 25-jointed, wings not areolate.

Monomera is represented by one family, the Coccidæ. Dimera includes the Psyllidæ, the Aleurodidæ, and the Aphididæ and Trimera includes the Auchenorrhyncha, on the phylogenetic position of which the authorities disagree.

It is admitted by all that among the trimerous insects the Cicadidæ are the lowest and most generalized, due to the presence of the three ocelli, the venation of the wings, and the poor development of the nervous system.

Here the question arises whether the Membracidæ should follow the Cicadidæ or the Fulgoridæ. It is the opinion of some writers that the Cicadellidæ, because their morphological characteristics and mode of development, occupy the highest rank among the Auchenorrhyncha. Funkhauser[10] however suggests that the membracids should be placed between the Cicadidæ and the Cicadellidæ, because the treehoppers have strong affinities with the leafhoppers, and probably came from the same

[1] Fauna Brit. Ind. Rhynch. 3 (1906) 52.
[10] Cornell Univ. Agr. Exp. Sta. Mem. 34 (1920) 322.

stem as the Cicadellidæ. Lawson,[4] in having the Cicadellidæ follow the Membracidæ, bases his opinion on the New World insect known as *Aetalion*, which looks very much like the Cicadellidæ and has certain characteristics that led Stål and Van Duzee to place it with the Membracidæ and Ashmead to place it under the Bythoscopidæ. Again he bases his reason for such arrangement on Fenton's[5] work on leaf hopper parasites, according to which *Apanteles* is the only genus of the Aphidiinæ that parasitizes the Typhlocybinæ and is also the only genus that was found on the Membracidæ, and as such the Typhlocybinæ are considered the lowest subfamily of the Cicadellidæ, closest to the Membracidæ. Fenton shows that the Aphidiinæ parasitize the Membracidæ, Cicadellidæ and Fulgoridæ. Thus the three above families show close affinities. Because of the protective froth which envelops the young, the Cercopidæ escape parasitism.

Imms[6] also is of the opinion that the Membracidæ are most nearly related to the Cicadellidæ. Edwards[7] arranged the families so that the Membracidæ follow the Cicadellidæ, and the Fulgoridæ (Issidæ) follow the Cicadellidæ (in part comprising Deltocephalinæ). Davis[8] places the Cicadellidæ between the Membracidæ and the Fulgoridæ. However, he admits the close relationship between the Cercopidæ and the Cicadellidæ. He says that *Penthimia americana* Fitch and certain species of *Gypona* and the Acocephalini closely resemble the cercopids. The most striking of the Australian forms are the much larger species of the *Eurymela* group of genera comprising *Eurymela*, *Eurymelodes* and *Eurymelops*. According to Tillyard,[9] these handsome wedge-shaped species superficially resemble the Cercopidæ. In my collection I have a *Poophilus*, a cercopid that is so similar to this group that only examination of the tibial spurs will prevent its confusion with the leafhoppers. As a group, DeLong adds, the Fulgoridæ are most easily confused with the Cicadellidæ. Dustan,[10] however, had the families arranged as follows:

[4] Kansas Univ. Bull. 32 (1920) 38.
[5] Ohio Journ. Sc. 18 (1918).
[6] A General Textbook of Entomology. Dutton & Co. Inc., New York (1925) 257.
[7] Hemiptera-Homoptera of the British Isles. L. Reeve & Co. (1896) 13.
[8] Cornell Coöl. & Nat. Hist. Surv. Bull. 20 (1923) 50.
[9] The Insects of Australia and New Zealand. Angus & Robertson, Ltd. (1926) 164.
[10] Fauna Brit. Ind. Rhynch. 3 (1906) 53–54.

Cicadidæ, Fulgoridæ Membracidæ, Cercopidæ. I do not clearly see the purpose of such arrangement. It seems that with the position and development of the ocelli, the antennæ, the prothorax the wing texture and the tibial spurs (spines), the following arrangement might be followed The Cicadidæ are the lowest and most generalized of the Homoptera. The Membracidæ, due to the poor development of the nervous system and the peculiar absence of the forms, which explains the absence of the third ocellus (wings very generalized, simple genital organs) and the peculiar and useless development of the scutellum, come second. The Cercopidæ, with less bizarre form and texture of the wings, scutellum the arrangement of the tibial spurs (wanting in Cicadidæ) the ocelli and the antennæ might be subordinated [illegible] however, for the reason that some of them generally resemble the Membracidæ more close The species of *Machærotypus* have the scutellar process long and arched, its apex extending over the same manner as that of the membracids In *Machæropsis* the scutellar process gradually shows recession Distant[14] claims [illegible] the Membracidæ and the Cercopidæ and the Cercopidæ should be subordinated to the Cicadellidæ The Fulgoridæ, with the location of the antennæ (which are lower than in the Cicadellidæ) and the scutellar development, may be considered the most modern and specialized family of the Homoptera

The Cicadellidæ belong to the division Trimera, and are one of the five families in this group namely, the Cicadidæ or 'harvest flies, the members of which are the largest species of the group the Fulgoridæ, or 'lantern flies," which feed on the leaves and stems of herbaceous plants the Membracidæ or 'treehoppers," which feed on twigs, the Cercopidæ, or "froghoppers," also known as "spittle bugs' because of the frothy masses that they make on the stems of grasses, and the Cicadellidæ or "leafhoppers," which feed mostly on the leaves of plants. Kirkaldy[15] defines "leafhoppers' as a convenient nontechnical term, to express auchenorhynchous Homoptera excluding the [illegible] (Cheermidæ), generally known as "jumping plant lice.

[14] Op. cit. 4 (1906) 79

[15] Rep. Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 6 (1906)

The large family Cicadellidæ is separated from the other related groups by the more or less closely spinulose condition of the posterior tibia and the position of the ocelli. The position of this important family has been the subject of considerable difference of opinion among workers. Westwood recognized only three families in the order Homoptera, namely Cicadidæ, Fulgoridæ, and Cercopidæ. Stål, supported by Hansen, recognized four, namely, Stridulantes, Cercopida, Fulgorida, and Jassida which include Membracida (Distant[28]). Edwards,[1] excluding Psyllina, enumerated fifteen families, which some under the present subdivision of the group Cicadina are the with one genus, Ulopidæ with one genus Paropidæ, with one genus [illegible] Typhlocybidæ are considered families. Kirkaldy[2] placed under the superfamily Tettigonioidea the family Tettigonidæ with 8 subfamilies: Tettigoniinæ, Jassinæ, Agalliinæ, Penthimiinæ, [illegible] Stenocotinæ, Kolobesthinæ and Deltocephalinæ.

Baker[3] opposed what he termed the "antiquated artificial system originally proposed for a few genera formerly known in Europe, namely, if the ocelli are located on the disk, the specimen is a tettigonellid, if on the margin, a jassid, and if on the face a bythoscopid. He listed under the superfamily Jassoidea fifteen families, namely Tettigonellidæ, Jassidæ, characteristics of which comprise those of the members of the *Tettigoniella* of Distant[28] excluding the genera *Signoretia*, *Prea*, *Eucondylus* and *Bundera*, the Gyponinæ, without the genus *Penthimia*. Penthimiidæ, those of the genus *Penthimia*. Thaumatoscopidæ taking in the genera of Kirkaldy, *Thaumatoscopus* (allied to *Gypona*, and *Penthimia* and *Vulturnus* which I would consider a *Thaumatoscopus* itself, there is hardly sufficient reason for placing *Vulturnus* to the entirety of a genus, Ledridæ, those of the subfamily Ledrinæ. Paropidæ, taking the genera *Mesoparopsis* of Matsumura and *Paropia*. Stenocotidæ with the genera *Stenocotus* and *Kyphocotus*, Koebeliidæ, the genus *Koebelia*, the Ulopidæ, under which belong the genera *Ulopa* and *Neoaliturus*, Signoretiidæ, *Signoretia* of Stål and *Prea*

[1] Fauna Brit. Ind. Rhynch. 2 (1916) 50-54.
[2] New genera Homoptera of the British Isles. L. Reeves & Co. (1906).
[3] Rep. Exp. Sta. New Sugar Planters' Assoc. Bull. 1 pt. 2 (1906).
[28] Philip. Journ. Sci. 24 (1923) 57-7.
[1] Fauna Brit. Ind. Rhynch. 4 (1908), 201-203.

of Distant, Eucanthidæ, *Eucanthus* and *Bundera*, Pythaminæ, consisting of *Onukia*, *Pythanus* and *Omeda*. Nirvaninæ having *Kana* Distant, *Ophicraus* Distant, *Stenometopius* Matsumura, and *Nirvana* Kirkaldy, and the genera recently erected by Baker *Pseudonirvana*, *Nirvanoides*, *Pythonirvana*, and *Jassonirvana*.

DeLong,[2] considering the Connecticut species, divides the Cicadellidæ into four subfamilies based principally upon the location of the ocelli and the shape of the body: Bythoscopinæ, Jassinæ, Cicadellinæ, and Gyponinæ. The Typhlocybinæ becomes a tribe of the Jassinæ. Distant, following in the main the classification of Van Duzee, divided the Cicadellidæ into seven subfamilies: Lodianæ, Bythoscopinæ, Tettigoniellinæ, Gyponinæ, Acocephalinæ, Jassinæ, and Typhlocybinæ. However the Acocephalinæ are absorbed by the Jassinæ in his synopsis of the genera.

Lastly, Melichar[3] divided this family into two large sections, based mainly upon the shape and sculpture of the vertex and pronotum, the Proconiaria with 54 genera, and the Cicadellaria with 100 genera. However according to China,[4] many of Melichar's generic names were preoccupied. Inasmuch as Melichar's types and discussed species were from southern America, and in view of this radical change in classification, I shall mention his work only as a reference.

CHIEF CHARACTERISTICS OF THE CICADELLIDÆ

In the classification of the Philippine species described herein the main features or characteristics of the groups were taken into consideration according to different authorities with special reference to the work of Distant[5] and of Osborn.[6]

Family CICADELLIDÆ Latreille

Cicadellæ LATREILLE, Fam. Nat. Reg. An. (1825) 427.
Cicadellina BURMEISTER, Handb. d. Ent. 11 (1835) 103.
Cicadellaires BLANCHARD, Hist. des Ins. Hemip. (1840) 187.
Tettigoniadæ FITCH, Homop., Fourth Ann. Rep. N. Y. State Cab. Nat. Hist. (1841) 55.
Jassina STÅL, Stet. Ent. Zeit. 9 (1858) 234.
Jassidæ FIEBER, Verh. Zool. Bot. Ges. Wien 16 (1866) 500.
Jassoidæ VAN DUZEE, Trans. Am. Ent. Soc. 19 (1892) 236.
Tettigoniodæ KIRKALDY, Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 2 (1906) 295.

[2] Conn. Geol. & Nat. Hist. Surv. Bull. 34 (1923).
[3] Ann. Mus. Nat. Hungar. 21 (1924) 195-243.
[4] Ann. & Mag. Nat. Hist. IX. 20 (1927) 281.
[5] Fauna Brit. Ind. Rhynch. 4 (1908).
[6] Ohio Biol. Surv. 3 No. 4 (1928).

The family Cicadellidæ was divided into seven subfamilies, namely, Ledrinæ, Bythoscopinæ, Tettigonellinæ, Gyponinæ, Acocephalinæ, Jassinæ, and Typhlocybinæ. As a matter of convenience the groups under the subfamily Acocephalinæ were placed under Jassinæ.

The insects are comparatively small, ranging from 2 millimeters in length, including the tegmina, among the Typhlocybinæ, to 18 millimeters among the Ledrinæ; tibiæ more or less elongated, hind tibiæ characteristically armed with a double row of spines, tarsi 3-jointed, ocelli two, placed on the anterior part, usually slightly above the margin of apex, in the Bythoscopinæ in front, below the margin, in the Tettigonellinæ, Gyponinæ, and Ledrinæ, on the vertex (sometimes variable in the Ledrinæ), and in the Typhlocybinæ the ocelli are wanting; the antennæ setaceous, 2-jointed, and terminated by fine long hairs, invariably placed between the frons and the eyes; the tegmina, or superior wings, are thicker than the membraneous, or inferior, wings, which are folded at rest.

In the Cicadellinæ the position of the ocelli, the shape, size, and sculpture of the vertex, pronotum, and scutellum, the shape and size of the frons and the clypeus, the arrangement of the venation, the coloration or markings, and the external and internal characters of the genitalia are the principal taxonomic features for the grouping and the separation of species.

LEDRINÆ

Head broad, face moderately concave or somewhat convex; vertex spatulate, horizontally rounded, narrowly depressed or moderately convex, cheeks flat and white; frons and clypeus narrowly produced, antennæ inserted under the anterior part of head above the line of the eyes and far from them.

The only species studied was a *Petalocephala* in the Osborn collection.

Genus PETALOCEPHALA Stål

Petalocephala STÅL, Öfv. Vet.-Akad. Förh. (1853) 206.
Ledropsis MELICHAR, nec White, Ann. Faun. Ceylon (1903) 141.

Type, *P. bohemani* Stål, from Java.

Distribution: Ethiopian, Oriental, Malayan, and Australian Regions.

Body very oblong or a little elongate, depressed; head clypeated, foliaceously produced anteriorly; vertex somewhat flattened, face beneath eyes strongly and abruptly thence gradually narrowed; margins very slightly defined; front small, narrow, flattish; eyes small; ocelli situated towards base of vertex, farther removed from the eyes than from each other; pro-

corium transversely semiangular, not, or only slightly, narrowed anteriorly the latera margins quite anterior latera much longer than posterior latera anterior margin slightly rounded scutellum triangular, subequilateral, tegmina subcoriaceous pellucid, closely punctulate tectiform anteriorly conjointly convex, clavus very broad before the middle, corium obliquely rounded at apex, veins somewhat irregularly anastomosed towards apex legs somewhat short, anterior coxae free posterior tibiae remotely setulate. Stål translated by Distant Fauna Brit. Ind. Rhynch. 4 (1908) 162-163.

PETALOCEPHALA CULTELLIFERA Walker.

Petalocephala cultellifera Walker Journ. Linn. Soc. Zool. 1 (1856) 98. *Ledra punctifera* Walker, List. Hom. Suppl. (1858) 248, Atkinson Journ. As. Soc. Bengal 64 (1895) 95.

Originally known from Sikkim, Mungphu (Atkinson collection), Darjeling (Brit. Mus.), Malay Peninsula, Perak (*Doherty*), Singapore (*Wallace*, Brit. Mus.), Distant.[70]

Length excl. tegmina 15 to 17, exp. tegmina 28 to 32 millimeters.

Yellowish or ochraceous, vertex about as long as broad between eyes, medially produced towards apex, thickly finely punctate, centrally longitudinally carinate, pronotum finely punctate, posteriorly finely rugulose, centrally longitudinally linearly impressed, tegmina thickly punctate, posterior tibiae inwardly strongly setulate. Distant Fauna Brit. Ind. 4 (1908) 164.

Luzon: Mountain Province, Haight's Place, Bauban (Osborn collection). This is the first Philippine record.

EYTHOSCOPINÆ

This subfamily is readily recognized by having the ocelli on the face below the anterior edge of the head, the vertex narrow or apparently wanting, the head being entirely deflexed.

Key to the Philippine genera of the subfamily Eythoscopinæ.

a Tegmina without an appendix.
  b[1] Pronotum distinctly produced beyond the anterior margin of the eyes and oblique rugæ. *Macropsera* Lewis.
a Tegmina with a distinct appendix.
  b Pronotum not produced beyond the anterior margins of the eyes.
    c[1] Vertex with eyes much broader than pronotum; head rounded.
      d Ocelli nearer the eyes than each other. *Idioscopus* Lewis.
      d Ocelli equidistant from each other and the eyes. *Idioscopsis* Baker.
    c[2] Vertex with eyes slightly broader than pronotum, transverse; head blunt, transversely depressed. *Gyponana* Germar.
  b[2] Pronotum shorter and narrower than the scutellum and vertex together. *Catonia* Distant.

[70] Fauna Brit. Ind. Rhynch. 4 (1908) 164.

Genus MACROPSIS Lewis

Macropsis LEWIS, Trans. Ent. Soc. Lond. 4 (1856) 40
Pediopsis DISTANT, Gen. Ins. (1908) pl. 10.

The very narrow vertex is distinctly produced beyond the anterior margins of the eyes. The head is as wide as the pronotum. The lateral margins of the pronotum are short, the anterior margin as in *Typhlocyba*, the posterior concave, and the surface obliquely striated, the scutellum with a transverse depression before the apex, angle slightly broader than long, the tegmina thin and folded over the body as in *Erythroneura*.

In this genus the males are darker and occasionally spotted (although the males of Nearctic species often show fewer markings than the females). The markings are not found in females of this genus, whereas in *Idiocerus*, a genus of the same subfamily, the spots are found in the females.

This genus, although apparently of world-wide distribution, has not been recorded from the Malayan region. Stål[34] described one species, *Macropsis maculipennis*, which is said to be a *Erythroneura*. In Baker's collection there are several Japanese species determined by Matsumura under *Pediopsis*, which is a synonym of *Macropsis*. There are three specimens labeled *Macropsis*, but they belong to the genus *Erythroneura*.

Breakey,[35] speaking of the geographic distribution, says that the genus is best known from the North Temperate Zone, and according to references found by him, ten species are described from the Ethiopian Region, four from Australia, one from Santo Domingo, eleven from the British Isles, outside of the thirty-two species and three varieties recognized by him as present in North America. Osbahr[36] records four species and one variety from Europe, one of them is a *Pediopsis* which was also recorded from Siberia, one from Japan, and two from China. Fowler[37] records two species of *Stragania* Stål, from Mexico, which were treated as a subgenus of *Gypona* and subsequently placed under the Jassinæ by Stål himself as being synonymous with *Macropsis* Lewis. In this paper (Hemiptera Africana 4 126–127) he renamed *Erythroneura obscurosa* Stål *Macropsis subobscurosa* Stål. Distant[38] described three species of *Pediopsis*

[34] Öfv. Vet. Akad. Förh. 27 1870
[35] Ann. Ent. Soc. Am. 38 (1945) 4
[36] Ann. Mus. Zool. R. S. 11 (1906) 67–69
[37] Biol. Cen. Am. Rhynch. 2 pt. 1 1909 27
[38] Fauna Br. Ind. Rhynch. 6 (1910) 288–289

sis *Macropsis* from India. These so far are the only *Macropsis* species known in the Indian fauna. Cogan[36] described one more species from Africa (*Pediopsis capensis*).

Specimens of the following new species were compared with Nearctic and Palearctic species at the United States National Museum.

MACROPSIS BREAKEYI sp. nov.

Female, length, including tegmina, 3 millimeters; male, length including tegmina, 2.8.

Very small, robust, ochraceous all over; vertex regularly and transversely punctured with brown punctures, and transversely striated about one-fourth as long as the distance between eye and middle of vertex; pronotum extended anteriorly, right angled, median line indistinct, oblique striation rugulose, regularly punctured with brown, posterior angles in line with scutellum; oblique posterior side slightly concave. Scutellum lightly punctured; face slightly tumid, appearing rugose from the side; clypeus minute; lora and genæ almost invisible; ochraceous plates of male long and spreading, the last ventral segment of female almost truncate, slightly projected at middle; pygofers very large; tegmina sordid hyaline, profusely and finely punctured with brown punctures.

MINDANAO: Zamboanga (holotype, Baker collection U. S. N. M.).

I take pleasure in naming this beautiful species for Dr. E. P. Breakey, of the Department of Zoölogy and Entomology, Ohio State University, a homopterist to whom I am indebted for valuable suggestions and criticism during the progress of this work.

MACROPSIS RIZALI sp. nov.

Female, length, 4.5 millimeters.

Head, pronotum and scutellum yellow; face, legs, and body beneath ochraceous, with brownish markings on the abdominal segments and pygofers; somewhat slender in form. Tegmina long, greenish transparent, with venation prominent, deeper green and yellowish green. Slender and medium-sized species. Pronotum regularly rugose, lightly marked with brownish patch on the anterolateral angle prominently produced, anteriorly almost right angled, posterior side slightly concave. Median line obsolete; scutellum subtriangular, slightly broader than long, finely punctured. Face broad, slightly tumid when viewed from

[36] Ohio Journ. Sc. 14: 191 (1916).

side forehead regularly and finely striated, frons elongated, slightly differentiated by shallow suture, ocypeus short and broadly rounded, lora minute, narrow, and elongated, gena narrow and elongated, depressed below the area of face, broader at apex, anal ventral segment a projecting semicircular plate, slightly notched

MINDANAO. Zamboanga Province, Dapitan (type and paratype, Baker collection, U. S. N. M.)

I am naming this species for the foremost Philippine hero, Dr Jose Rizal, physician and scientist who spent a few years in Dapitan as a political exile during the Spanish domination of these Islands

[illegible]

Female, length, 6 millimeters, male, length, 5

Pale ochraceous with profuse brown and fuscous markings on the pronotum and scutellum tegmina light brown with profuse fuscous markings. Male slightly darker

Vertex almost invisible from dorsal view, obtuse-angled, at the middle much narrower than the portions close to the eyes, appearing as a line pronotum obtuse-angled, broader than long, moderately convex, with a very distinct fuscous blotch or marking on each side of the anterior line, midway between the anterolateral and the median line which is slightly carinate or ridged, the oblique rugæ, starting from the upper middle portion to the lower side and gradually to the umbral angle, very prominent and roughly punctured, middle portion of the pronotum profusely marked with brown, scutellum ochraceous, roughly punctured posterior angle sharply pointed and separated by an arcuate suture, somewhat striated with transverse strigæ on upper lateral angle with obliquely triangular fuscous markings, face ochraceous, broad, almost flat, slightly tinged on the clypeal portion contour slightly rough, coarsely and profusely punctured frons sordid, tinged with ferruginous, especially in males eyes brown with slight fuscous blotch on inner portion, lora and genæ minute, ocelli on the face between eyes and frons, antennæ minute, beneath the inner posterior angle of the eyes, above the deeply sulcated cheek, pectus and venter ochraceous with fuscous markings on the portions of the prosternum and metasternum femora, tibiæ and tarsi especially noticeable in males, tegmina membranous brown, strongly corrugate, sordidly marked with irregular fuscous markings venation prominent, ochraceous, stippled with fuscous. A robust species.

LUZON, Benguet Subprovince, Baguio (type and allotype, Baker collection, U. S. N. M.).

MACROPES SUBVIRIDIS sp. nov.

Male and female, length, 4 millimeters.

Pronotum and scutellum of the female grass green, the pronotum of the male pale brown with profuse fuscous punctures, the scutellum of the same color and with the same punctures and with one fuscous triangular marking on each of the three angles, eyes grayish with crimson tinge, the face, pectus, legs, and venter of female greenish ochraceous, with brown markings on the legs, those of the male ochraceous, with brown punctures on the face, and brownish markings on the legs. Dimorphism is distinct in this species.

Pronotum convex, slightly less than a right angle, oblique impressions prominent, median line present, about two-thirds as long as broad, the posterior side narrowed and concave, scutellum almost as long as broad as long as the pronotum, median line present, posterior angle separated with arcuated suture, with coarse brown punctures, face with median line also, rough surface, slightly longitudinally carinate on the middle, gena small and depressed, narrow margin extended to the base of clypeus, which is also small and narrowed at apex, the plates of the genitalia slender and elongate (*fusiformis*) the last ventral segment of the female small, wedge-shaped, tegmina long, smoky pale brown with very prominent fuscous venation.

LUZON, Benguet Subprovince, Baguio (type and allotype, Baker collection, U. S. N. M.).

MACROPES PUNCTIPUNCTATA sp. nov.

Female length, about 4.75 millimeters.

Greenish ochraceous with sordid brown prominent punctures on vertex, head, face, pronotum, scutellum and tegmina, quite similar in form to *M. fusconervosa*, but slightly larger, pectus and legs with brownish markings.

Pronotum distinctly angulate anteriorly rectangular, median line distinct, strigae profusely punctured with brown dots, rugulose posterolateral angles rounded, middle posterior side slightly concave, scutellum greenish ochraceous, with median line profusely punctured with brown spots, especially the three angles, the posterior separated by an arcuated suture, face roughly striated and punctured, sordidly marked with brown markings, oblique striation from middle to the eyes deep, median line present reaching nearly to clypeus, frons distinguished by two

parallel, semicircular, brown lines, clypeus broadly rounded, lora and genæ small, pectus and legs with brown markings, venter greenish ochraceous, last ventral segment transversely triangular, wedge-shaped, tegmina smoky hyaline, long, with profuse brown punctures, especially the commissural region, venation punctured all over with brown

Luzon, Benguet Subprovince, Baguio (type and paratype, Baker collection, U S N M)

MACROPSIS BYARSI sp. nov.

Female, length, 4.25 millimeters, male, length, 4.25

Testaceous to fuscous, medium-sized, face, pectus, legs and venter ochraceous, with a brown tinge, the upper portion of the head semitransparent fuscous. Vertex very narrow and projected in front about one-fifth as broad as the distance between the eye and one-half of the vertex, pronotum testaceous, with short, fine, oblique striation regularly and profusely punctured with fuscous punctures, median line absent, acutely angled, slightly more than right-angled, about three-fourths as long as wide between humeral angles, posterior side subtruncate area of scutellum more testaceous and less thickly punctate, lateral angles smoothly brown, transversal suture separating the posterior angle face smoothly rugose, ocelli ochraceous, situated between and near the eyes, legs and venter ochraceous with brownish tinge, pygofer orange-brown, the plates castaneous, tegmina fuscous to castaneous, with irregular fuscous markings

BASILAN (type and allotype) MINDANAO, Zamboanga (paratypes, Baker collection, U S N M)

I take pleasure in naming this species for my friend and loyal assistant Mr F Q Otanes, of Manila, who from time to time has supplied me with homopterous insects for determination

MACROPSIS BASILANA sp. nov.

Female, length, including tegmina, 5 millimeters

Dark brownish ochraceous, vertex pronotum, and scutellum ochraceous with a brown marking on each basal angle of scutellum tegmina sordid hyaline brown with fuscous markings at the ends of principal veins, and division of principal cells, face, pectus, venter, and legs ochraceous, pygofer with a brown patch on the middle of each sheath, ovipositor exceeds the length of the pygofer considerably as long as tegmina or slightly longer vertex acutely produced slightly more than right-angled, about one-fourth as long as the distance from the middle to the eyes,

transversely and briefly striated, finely punctured, with fine testaceous dots, pronotum with same color ornamentation and sculpture as the vertex, produced slightly more than a right angle in front posterior side somewhat concave, markings on center and posterior side darker than rest, median line absent face, forehead center semihyaline, brown rugose clypeus, tora and gena minute similar to *M otanesi* but relatively slenderer and longer especially the ovipositor

BASILAN (type) MINDANAO, Zamboanga (paratype, Baker collection, U S N M

MACROPSIS LUZONENSIS sp. nov

Female, length, including tegmina 4.5 millimeters, male length, including tegmina 4

Yellowish brown, pectus and legs of female brownish ochraceous, with brown tinge on venter and pygofer, those of male greenish ochraceous, tegmina similar to those of *M basilana*, but the markings finer, the colors similar to *M basilana*, but size and general conformations similar to those of *M otanesi*

Vertex very short, about one-fourth as long as the distance from the center to the eye greatly produced in front, slightly more than right-angled, anterior side of pronotum greatly produced, median line absent, oblique striation and punctures fine and concolorous, about two-thirds as long as broad, anterior angle concave scutellum slightly lighter posterior angle impressed before apex.

LUZON Laguna Province, Mount Maquiling (type and paratypes, Baker collection, U. S. N M.)

MACROPSIS DAPITANA sp. nov

Female, length including tegmina, 5.5 millimeters.

Vertex short longer at the side near the eye middle portion somewhat fine olive-brown regularly punctured pronotum roundly produced, less than right-angled, about twice as broad as the length, coarsely and regularly punctured, posterior side roundly and gradually concave, scutellum orange-brown equilaterally triangular, regularly and finely punctured, face roundly tumid olive-brown, pectus black legs and venter brown, last abdominal segment trisinuate tegmina olive-brown venation orange-brownish

MINDANAO, Zamboanga Province, Dapitan (type and paratypes Baker collection, U S N M)

MACROPSIS DAVAOENSIS sp. nov.

Female. length, including tegmina, about 3 millimeters.

Similar in size and shape to *M. mindanaoensis*. Vertex and pronotum greenish ochraceous, fine striation and punctures concolorous, median line indistinct; scutellum yellowish ochraceous with fine brown punctures all over, apical angle with shallow and short impressed suture; tegmina hyaline, sordid brown with profuse brown to fuscous spots, face greenish ochraceous, slightly fumid and finely stippled; pectus, legs, and venter brownish ochraceous with brown markings.

MINDANAO: Davao Province, Davao (type); Lanao Province, Iligan (paratype, Baker collection, U. S. N. M.).

Genus IDIOCERUS Lewis

Idiocerus LEWIS, Trans. Ent. Soc. Lond. 1 (1836) 47.
Idioscopus BAKER, Philip. Journ. Sci. § D 10 (1915) 338.

Type *I. adustus* H. S., a Palæarctic species.

The head is broad and very short, the vertex merging into the front. The eyes prominent, the elytra long, usually narrowing toward the tip, the body appearing wedge-shaped and the nervures are strong, often being set with tubercles or papillæ alternately. The male antennæ are peculiar in having swollen disc-like portions near the tips of the setæ.—OSBORN and BALL, Proc. Davenport Acad. Nat. Sci. 7 (1898) 124.

According to Osborn,[37] "the larvæ differ from other tree inhabiting forms in having broad heads and thorax and long slender cylindrical abdomen." They are found most abundant and in swarms during the dry weather from February to April.

Baker [38] made *Idiocerus clypealis* Lethierry the type of a new genus *Idioscopus* and included therein two new species, *palawanensis* and *tagalicus*, because, he states, the head is larger, narrower, and longer as seen from above. He says that it is distinctly longer at the middle than at the eyes, that it is long in proportion to width between eyes, and that the first apical and first subapical cells are confluent. The generic characteristics of this species seem to tally exactly with those of *Idiocerus* as given by Distant from Osborn and Ball.[39]

IDIOCERUS CLYPEALIS Lethierry

Idiocerus clypealis LETHIERRY, Journ. As. Soc. Bengal 58 (1889) 262, ATKINSON, Ind. Mus. Notes 4 (1891) 187, DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 137.

[37] Bio. Biol. Sur. 2 (1928) 209.
[38] Philip. Journ. Sci. § D 10 (1915) 337-343.
[39] Proc. Davenport Acad. Nat. Sci. 7 (1898) 124.

Idiocerus nivecosparsus MELICHAR, Hem. Fauna Ceylon (1903) 148, pl. 5, figs. a, b.

Idiocerus elongatus Lethierry BAKER, Philip. Journ. Sci., § D, 9 (1914) 339, 340.

Female.—Length, including tegmina, 4 millimeters.

Head, viewed from above, large, broad and short, the eye exceeding the pronotum, the vertex being only one-half as long as broad from the middle to the eye, apical cells four, subapical three, tegmina wedge-shaped, longer than the abdomen, being narrowed and folded behind, the exact characteristics for the genus. Distant, however, in describing it, did not state that it is the male that lacks the two spots on the anterior margin of head, a sexual characteristic. Neither did he mention the fact that it is the male that has the immaculate face, and that the female has two small spots on the frons between the eyes, another sexual differentiation.

Distant [6] stated that the clypeus is flavescent with a central longitudinal black facia; this feature is also absent. All of my specimens, male and female, have a uniform clypeus. The two spots on the apex of the vertex and the two on the frons are absent in the male.

"Habitat: Bengal, Calcutta, Pusa, Madras, Ceylon, Peradeniya, Colombo." (Distant.)

LUZON, Laguna Province, Los Baños (*Baker*). MINDANAO, Occidental Misamis Province, Oroquieta (*Merino*), on mango. Baker believes that this species occurring in swarms is as injurious to the mango plant as *C. nivecosparsus*.

Genus IDIOCERINUS Baker

Idiocerinus BAKER, Philip. Journ. Sci., § D, 10 (1915) 241.

Type, *I. melichari* Baker.

This genus was erected by Baker [7] on the form of the frons which, according to him, is different from any other Philippine Idiocerine insect. The clypeus is shorter compared to its width than in the other nearly related groups. Perhaps also the absence of the upper cubita branch of the wing veins and the reduction in size of the second apical cell are unique. Other characteristics are typical of *Idiocerus*.

[6] Fauna Brit. Ind. Rhynch. 4 (1908) 187.

[7] Philip. Journ. Sci., 10 (1915) 241.

[illegible] n. sp.

Female, length including tegmina, 4.5 millimeters.

Vertex virescent with ochraceous area on the median occupying two-thirds of the apex, frons and clypeus orange, cheeks and lora ochraceous, clypeus short and wide, pronotum with slightly more than two-thirds of the posterior area testaceous and the anterior or third virescent, transversely more than twice as long as the vertex, anterior margin rounded, posterior broadly truncate, scutellum equilateral, longer than the pronotum, testaceous, body beneath and legs ochraceous, last ventral segment truncate, tegmina long, apical cells four, the second outer reduced, upper cubital branch inconspicuous with distinct appendix, clavus area olive-green, the rest brown, venation fuscous, a longitudinal fuscous fascia from humerus, angle to apical margin, a fuscous patch at margin within the first and second apical cells.

LUZON, Laguna Province, Los Baños (type in my collection).

I am naming this species in honor of the late Prof. Charles Fuller Baker under whom I did my first field work in entomology.

Genus BYTHOSCOPUS Germar

Bythoscopus GERMAR, Silb. Rev. Ent. 1 (1833) 180; LEWIS, Trans. Ent. Soc. Lond. 1 (1836) 48; FIEBER, Verh. Zool. Bot. Ges. Wien 16 (1866) 456-466; Rev. Mag. Zool. (3) 3 (1875) 389; KIRKALDY, Ent. 34 (1901) 340, Exp. Sta. Haw. Sugar Planters Assoc. Bull. 1 (1906) 344; 3 (1907) 31; Distant, Fauna Brit. Ind. Rhynch. 4 (1908) 190; VAN DUZEE, Ottawa Nat. 26 (1912) 60.

Aedra Aemorgina LEWIS, Trans. Ent. Soc. Lond. 1 (1835) 51; WESTWOOD, Intr. Mod. Classif. Insects 2 Synop. (1840), 117; KIRKALDY, Ent. 34 (1901) 219 (names preoccupied) (type).

Macropsis AMYOT and SERVILLE, Hem. (1843) 186; FIEBER, Verh. Zool.-Bot. Ges. Wien 16 (1866) 441; STÅL, Hem. Afr. 4 (1866) 126; KIRSCHBAUM, Cicad. 3 Wiesbd. (1868) 16; SAUNDERS, Cicad. (1871) 113; FIEBER, Cicad. d'Eur. 1 (1875) 101; MAYER, Tabellen (1884) 26; EDWARDS, Trans. Ent. Soc. Lond. (1885) 104; ASHMEAD, Ent. Am. 5 (1889) 125; VAN DUZEE, Ent. Am. 6 (1890) 69, Trans. Am. Ent. Soc. 21 (1894) 280; DALL, Psyche 9 (1900) 28; OSBORN, Vers. Palae. Hem. 2 (1900) 67, Kat. Pal. Hem. (1912) 101; DeLong, Trans. St. Ed. Ent. Soc. 7 (1914) 3.

Stragania STÅL, Ent. Jan. Hem. 2 (1862) 49; FOWLER, Biol. Centr. Am. Hom. 1 (1903) 318.

Pachyopsis UHLER, Bull. U. S. Geol. Surv. 3 (1877) 608 (type Aedra Uhleri); ASHMEAD, Ent. Am. 5 (1889) 145.

Gargaropsis FOWLER, Biol. Centr. Am. Hom. 2 (1896) 167.

Type, *B. lanio* Linnæus.

Distribution: Universal.

General appearance broad and robust. head short and bluntly rounded, face broad and short frons greatly raised from cheeks pronotum slightly wider than long coarsely transversely striated, anterior margin rounded, posterior margin slightly concave, almost truncate posterolaterals oblique, slightly rounded at corners, tegmina moderately long and tapering towards the end, the tip narrow and rounded venation reticulated or longitudinally punctured

Distribution Benga Calcutta, Ceylon, Tenassarim

ERYTHROSCOPUS CHLOROPHANUS Melichar.

Hercopis chlorophanus LETHIERRY (*Pachypoeus*), Bul Soc Zool Fr (1892) 209 MELICHAR, Hom Fauna Ceylon (1903) 158, DISTANT, Fauna Br Ind Rhynch. 4 1908) 197 fig 124 MELICHAR Notes Leyd Mus. 35 1914 121, OSBORN Pacific Ent Pub 7 (1934) 241.

Male, length, about 4.5 millimeters, female, length, about 5.

Vertex, pronotum, and scutellum light green to stramineous, tegmina greenish ochraceous with piceous spots at end of clavus, face yellowish ochraceous to stramineous. body beneath and legs greenish ochraceous. Vertex narrow and broad, its length about one-sixth the distance between the eyes Vertex with the eyes narrower than the pronotum pronotum slightly broader than long, transversely striated anterior margin rounded, posterior margin almost truncate scutellum subtriangular, slightly narrower than broad, apical angle impressed with transverse line and separated by an arcuate impressed line, the rest finely punctured, eyes brick red ocelli nearer to the eyes than to each other face broad and short, surrounded by short striae venation longitudinally punctured

This species is here reported from the Philippines for the first time

LUZON, Laguna Province Los Baños. Mount Banahao Bataan Province, Mount Limay MINDANAO. PALAWAN

Genus **CHUNRA** Distant

Chunra DISTANT Fauna Brit Ind. Rhynch 4 (1908) 198 BAKER Philip. Journ Sc § D 10 (1915) 324 326.

Type, *C. punctivenata* Walker

Distribution Oriental and Malayan Regions

Vertex very short and broad, with eyes distinctly broader than pronotum, face narrowed between eyes the ocelli about as near to each other as to eyes and placed a little below middle of eyes which are oblique and long and narrow and extend along the lateral margins of the pronotum pronotum twice as long as vertex the posterior margin concavely sinuate

scutellum very long and broad, longer than pronotum and vertex together transversely impressed before apical area which is moderately raised, the apical margin broadly subacute, less moderately slender, the posterior lobe thickly spinulose tegmina with the clavus posteriorly broadened to middle and then angularly narrowed to the clavus apex, apical areas four the upper or postcostal area short and moderately broad, wings ample —Distant, loc. cit.

CHUNRA NIVEOSPARSA Lethierry.

Chunra niveosparsa Lethierry Journ. As. Soc. Bengal 58 (1889) 252, Atkinson Ind. Mus. Notes 1 (1889) 5. No 4 (1891) 187 pl 12, fig. 6; Journ. As Soc Bengal 72 pt 2 (1903) 7 Baker, Philip. Journ Sci § D 10 (1915) 318 324 326.

Idiocerus basalis Melichar. Hom. Fauna Ceylon (1903) 147

Idiocerus niveosparsus Distant, Fauna Brit Ind Rhynch. 6 (1908) 186, fig. 121

Female, length, including tegmina, 4.25 millimeters.

Vertex ochraceous with large discal fuscous or olivaceous spots, front, clypeus, lora, and rostrum brown cheeks ochraceous, ocelli fuscous, located just above the suture of the rounded frons, the distance between them twice the distance between ocelli and eyes, eyes olivaceous; pronotum transverse, about three times as long as length of vertex rounded anteriorly, the lateral margin oblique and the posterior broadly sinuate, with olivaceous marking posteriorly, anterior margin lighter, scutellum equilateral, bronzy olive, as long as the pronotum, posterior angles light ochraceous, almost white, three spots of similar color above the tegmina darker bronzy olive, white transverse band from humeral angle to the posterior angle of scutellum, white marking at the posterior tip of the scutellum, and at posterior extremity of costa, area, white marking of costal area preceded by fuscous, venation and posterior margin fuscous.

Habitat Saharanpur Calcutta, Madras Bombay Province, Istalpur, Ceylon Peradeniya Philippine Distant loc. cit.

Baker[22] reported this insect from the Philippines and other Malayan countries, where it attacks mango flowers in swarms. He disagrees however, with the description and the illustration of Distant, and places the Philippine species under the genus *Chunra* Of this species he described three new varieties, namely, *Chunra niveosparsa* Leth. var *philippinensis*, var *palawanensis*, and var *fuscinervis*

The species described above from Oroquieta, Mindanao, tallies somewhat with the synopsis for var *minorensis* Baker The

[22] Philip. Journ. Sci § D 10 (1915) 324-326

frontoclypeal suture as shown in Distant's figure is not quite visible; moreover the marking on the scutellum is different from that of Distant.[43] Baker, however, was apparently in error in the discussion of this species. His citation referred to *Idiocerus mucosparsus* Lethierry, but his discussion was about the genus *Okanra* Distant. The Philippine species, however, is a *Okanra* and not an *Idiocerus*.

This species is associated in the Philippines with *Idiocerus exspectatus* Lethierry, which is destructive to mango trees, sucking the juices of the young shoots and the flowers, and causing the latter to wither and fall. Trees severely attacked produce few or no fruits. Mango growers in the Philippines smudge their trees daily long before inflorescence, some during the months of March and April. Spraying with soap solution or with nicotine sulphate just before the mango flower opens has been successful.

These two leaf hoppers are the most pernicious mango pests in the Philippines.

TETTIGONIELLINÆ

This subfamily is easily recognized by the presence of the areola on the disk of the vertex, the large and prominent convex face with long narrow cheeks, and the rounded or obtuse edge of the head.

Distant's synopsis includes eleven genera. Two other genera were described under this subfamily, making thirteen genera in all. I have added *Maxillingia* by Baker.[44] I have followed it, in the main, the great work of Distant. The following is a tentative key to the genera considered in this paper:

Key to the Philippine genera of the subfamily Tettigoniellinæ

a. Face neither convex by carinæ nor foveate.
  b. Lateral margins of vertex at the central margin of the eyes.
    c'. Vertex not foveate. ..... *Cicadella* Latreille
a'. Face globose, two carinations united posteriorly on basal area.
  b. Lateral margins of vertex at the central margin above the eyes.
    c. Vertex flattened or concave. ..... *Maxillingia* Baker
  b'. Lateral margins of vertex at the central margin of the eyes.
    c. Vertex with a fine central longitudinal carination and an oblique carination on each side of anterior area. ..... *Mileewa* Distant

Genus CICADELLA Latreille

Cicadella Latreille, in Cuvier Regne Animal 3 (1817) 466; Kirkaldy, Can. Ent. 39 (1907) 247; Van Duzee, Check List Hem. (1916) 66.

[43] Fauna Brit. Ind. Rhynch. 4 (1906) 193–194.
[44] Philip. Journ. Sci. 24 (1924) 67–70.

Tettigonia REAUMUR, Memoirs 5 (1740) 150 (pre-Linnean, GEOFFROY, Hist. Abreg. des Ins. (1762) 429, nom. praeoc.
Cicada FABRICIUS, Syst. Ent. (1775) 682 (name cited in error), *Cicada viridis* LINNÆUS, Syst. Nat. 1 (1758) 438.
Ablycephalus CURTIS, Brit. Ent. 7 (1830) 493.
Tettigonia JACOBI, Zool. Jahrb. 19 (1903) 778 nom. nov. DISTANT Fauna Brit. Ind. Rhynch. 4 (1908) 201.

Type, *C. viridis* Linnæus, a Palearctic species.

Vertex anteriorly convexly or subangularly produced, the lateral margins in a line with the inner margins of the eyes; face moderately globose, neither carinate nor foveate; moderately compact, lateral areas transversely striate, pronotum longer than vertex, the anterior margin more or less convex, posterior margin truncate; scutellum somewhat area, transversely impressed before the apical area; tegmina longer than abdomen, apical areas five, posterior two longly appendiculose.—DISTANT, loc. cit.

Most of the specimens in this collection are dark chocolate-brown with ferruginous head and upper third of pronotum; eye pitch black, apex of tegmina dark copper brown; the frons somewhat triangular, about as long as broad between eyes, ferruginous with the middle depressed and slightly streaked with light brown, laterally slightly striated; division of clypeus hardly visible, genæ and lora light ochraceous; pectus ochraceous, legs ferruginous; two anterior pairs of tibiæ and tarsal joints fuscous; venter orange with black band on the anterior halves of every segment, the last ventral segment ochraceous. There is a gradation of color from chocolate to dark brown among the specimens in my collection.

CICADELLA (TETTIGONIA) LONGA Walker.

Male, length, about 18 millimeters, female, length, about 14.

Ferruginous, slender; head, pale tawny beneath; head convex in front, face obtuse with a tawny disk, a dot on the abdomen; caseous; forewings with a black interrupted stripe near the hind border and another more modest one on the disk; hind-wings coppery.—WALKER, List. Hom. 1 (1851) 240.

LUZON, Rizal Province, Novaliches; Laguna Province, Los Baños.

According to Distant[1] this species is synonymous with *C. ferruginea*. However China in one of his determinations in the Baker collection labeled this species as distinct from *C. ferruginea*.

[1] Fauna Brit. Ind. Rhynch. 4 (1908) 202-203.

CICADELLA FERRUGINEA Fabricius

Tettigonicita ferruginea FABRICIUS *Cicada* Ent. Syst. 4 (1794) 32 Syst. Rhyng. 809) 62 GERMAR (*Tettigonia*, Mag. Ent. 4 (1821) 69, SIGNORET Ann. Soc. Ent. Fr. 853) 676, pl. 22, fig. 5 WALKER, List Hom. Suppl. 1858) 218 ATKINSON Journ. As. Soc. Benga 54 (1885) 33

Tettigonia apicalis WALKER, List Hom. 3 (1851) 736.

Tettigonia confinis WALKER, List Hom. 3 (1851) 736.

Tettigonia addita WALKER, List Hom. 3 (1851) 737

Tettigonia gemina WALKER, List Hom. 3 (1851) 737, MELICHAR, Hom. Fauna Ceylon (1903) 165

Tettigonia obscura WALKER, List Hom. 3 (1851) 738.

Tettigonia duplex WALKER, List Hom. 3 (1851) 738

Tettigonia reducta WALKER, List Hom. 3 (1851) 739

Tettigonia unvaculata WALKER, List Hom. 3 (1851) 740

Male, length including tegmina, about 13 millimeters

The last ventral segment of the female is deeply sinuate at the middle and roundly angled at the extremities of the lateral side That of the male is almost truncate, with the anal plates acutely triangular, it almost entirely covers the pygofer Of the distinguishing characteristics of this species the yellow abdomen with a semicircular black spot at the base of both lateral sides of each segment is unique

Habitat India, Burma, Malay Peninsula, Java, Sumatra, Borneo, Philippines, China, and Japan

LUZON, Manila.

CICADELLA IMPUDICA Signoret.

Tettigonia impudica SIGNORET Ann. Soc. Ent. Fr. (1853) 132 and 677 (Manila STÅL, Hem. Ins. Philippinarum 2 (1870) 733 TASCHENBERG Zeits. Natur. 57 (1884) 630 (Siam)

Tettigonella impudica Signoret BAKER, Philip. Journ. Sci. § D 4 (1909) 553 5 (1910) 60 (Palawan)

Female, length including tegmina, 13 millimeters, male, length, including tegmina 5

Reddish brown, slender, linear, head convex in front, face obtuse frons and clypeus reddish brown gena and lora grayish brown, frons with reddish orange longitudinal band on the center, dimly laterally and perpendicularly striated, vertex sulcated between eyes and ocelli, eyes fuscous, tegmina long, fuscous, brown at apex body beneath pectus reddish brown in female and ochraceous in male venter reddish brown, dorsally black, posterior wings black

This species is similar to the two preceding species, but is slightly smaller and slenderer and lighter brown The last ventral segment of the female is obtusely and somewhat roundly pro-

dated with a ridge at the center that is slightly lobed. The anal plates of the male are longer with a long filiform appendage about two-thirds as long as the rest of the plate slightly passing the pygofer, pygofer is more robust and profusely pilose.

Cicindella impudica has been found associated with *C. longa*.

Described by Signoret from a specimen collected in Manila. It is not known from anywhere else.

CICINDELLA PHILIPPINA Walker.

Cicindela philippina WALKER, Linn. Trans. Ins. 2 (1851) 760.
Tetracha philippina SIGNORET, Ann. Soc. Ent. III 1 (1853) 122 and 674, pl. 21, fig. 3; Stål, Öfv. Vet. Akad. Förh. 27 (1870) 713.

Female, length, including tegmina, 15 millimeters, males, length, including tegmina, 14.

Head, pronotum, and scutellum pitch black, vertex anteriorly rounded and bluntly produced, with a lateral marginal yellow fascia just before each eye, a median marginal fascia extending from the outer part of the vertex forward on to the front; ocelli amber yellow, eyes black, surrounded by a narrow ochraceous line; frons tumid, about one and one-half times as long as broad, margined by black fascia uniting just above the clypeus, frons separated by a compressed black line, hardly discernible, genæ and ora yellow, pronotum slightly transverse, slightly broader than long, basal side distally rounded, lateral side almost parallel, the margins somewhat inwardly sinuate, the two lateral yellow markings occupying almost two-thirds of area of the pronotum, scutellum and equilateral triangle with large, median, basal yellow marking, tegmina cherry red to fuscous. In males the commissure region and the costal area margined with black bands. The females with yellow patches as on the basal claval and on the basal costal regions, surrounded by dark fuscous areas, the rest of tegmina brown to cherry red, venation fuscous, body beneath pectus, and legs ochraceous-brown, abdominal region above black, venter fuscous with ochraceous terminal band on each segment. last ventral segment in female acutely angled on the lateral edges, slightly more acute than in *Cicindella longa*. Anal plates of the male similar to those of *C. longa*, *C. ferruginea*, and *C. impudica*. Female darker than the male ventrally.

The Baker collection from various parts of Mindanao contains a female of the coloration of the male described with specimens collected in Iligan, Kolambugan and Butuan. Some

of the specimens from Butuan are still darker with lighter areas on the middle extending down to the apices. This is true also of the specimens from Surigao. Some of these have the frontal markings continuous, while those of the vertex are indistinct.

MINDANAO, Zamboanga Province, Port Banga. Lanao Province, Mumungan (Osborn collection).

CICADELLA SPECTRA Distant

Tettigonia ribula WALKER, List Hom. Insects 1 (1851) 707. SIGNORET Ann. Soc. Ent. France (1853) pl. 21, fig. 3, STÅL, Hem. Afr. 4 (1866) 127. Öfv. Vet.-Akad. Förh. 27 (1870) 794, KIRKALDY Entomologist 23 (1890) 294, DUDGEON Abl. Sonah Nat. Gen. 29 (1900) 192, Abh. Naturf. Ges. Halle 24 (1901) 21, MELICHAR Hom. Fauna Ceylon 1 (1903) 157, Wien. Ent. Zeit. 24 (1905) 29. KIRKALDY Exp. Sta. Haw. Sugar Planters' Assoc. Bul. pt. 3 (1906) 319. BUZERAN Notes Leyd. Mus. 29 (1907), 33 (1910) 52 (nec Walker, 1851).

Tettigonia regalinea Stål, Öfv. Vet. Akad. Förh. 27 (1870) 795.

Tettigoniella spectra DISTANT Fauna Brit. Ind. Rhynch. 6 (1908) 211–212, fig. 137; MATSUMURA, Insect. Zuckerrohr Formosa (1910) 27. DISTANT Ins. Transvaal pt. 10 (1910) 253, fig. 41 (South Africa), MELICHAR, Notes Leyd. Mus. 36 (1913) 123 (Java), DISTANT, Fauna Brit. Ind. Rhynch. 7 (1918) 3, FERRERIRA, Proc. 3d Ent. Meeting, Pusa (1918) 177, DAMMERMAN Landbouwdierk. Oost. Ind. (1919) 150, FERRERIRA, Proc. 3d Ent. Meeting, Pusa 2 (1920) 274.

The four black spots on the vertex do not appear in Walker's description.

Distant[46] gives a new name for *spectra*, and according to him the localities are the following: Calcutta, E. Bengal, Pusa, Nepal, Jaunsar, Nagpur, Surat, Bombay, Ceylon Peradenya, North Australia, etc. No mention is made of the Philippines. He quotes E. E. Green about this insect, who says, "Makes itself a nuisance, swarming round lamps in the rooms at night," and N. Annandale, "Common at the edge of tanks. It is able to walk." Kirkaldy[47] gives an additional records of Queensland, Celebes and the Philippines, where it is found on sugar cane and various grasses, and Stål,[48] of Madagascar and West and South Africa.

In the Philippines this species is very common, swarming around lamps during the early part of the rainy season. It has been collected from Luzon to Mindanao.

[46] Fauna Brit. Ind. Rhynch. 6 (1908) 21.

[47] Exp. Sta. Haw. Sugar Planters' Assoc. Bull. 1 pt. 3 (1906) 319.

[48] Öfv. Vet.-Akad. Förh. 27 (1870) 794.

CICADELLA WHITEHEADI (Distant).

Tettigoniella whiteheadi DISTANT Rhynch. Malayana, Rec Ind. Mus. 11 pt. 1 (1908. 142-143 BAKER Philip. Journ. Sci. § D 9 (1914) 418 fig. 9

Female, length, about 11 millimeters.

Greenish pale ochraceous with fuscous venation. Tibiæ and tarsi fuscous, vertex with two black spots on apical margin, one black dot on each lateral margin, and one median angulated spot connected with a narrow black line to the base of the vertex pronotum rounded in front and slightly concave, the lateral sides oblique almost as long as broad, a longitudinal median black fascia attenuate on anterior third of pronotum, scutellum small with a longitudinal median fascia, anterior third almost indiscernible, a black margin on each upper clavus area bordering commissural line down to tip of clavus, face strongly turnid with a broad flattened front, lateral sides striated, striæ perpendicular to median parallel lines, tibiæ and tarsi fuscous.

LUZON Laguna Province Mount Banahao Mountain Province. Benguet Subprovince, Mount Santo Tomas (*J Valdez* Osborn collection)

CICADELLA DIFFERENTIALIS Baker

Cicadella differentialis BAKER, Philip. Journ. Sci § D 9 (1914) 420.

Female, length, including tegmina 7.5 millimeters.

Head, pronotum, and scutellum yellowish green Vertex anteriorly convex, sordidly striated with light brown striæ at apex, three black spots on disc, one on middle near base of vertex, and two on lateral margin near basal angle of face pronotum with a semilunar dark green line on middle upper edge, and three fairly large square green spots on middle part, tegmina with pale fuscous veins, body beneath pale green with yellowish spots at places, legs pale ochraceous, lateral sides of last ventral segment notched, clipped, with middle slightly indented at center

LUZON Laguna Province, Los Baños, Mount Banahao Bataan Province, Alabang (*J Valdez*) Mountain Province, Baguio (Osborn collection)

CICADELLA IMPERFECTIFRONS Stål

Cicadella imperfectifrons STÅL, Öfv. Vet Akad. Förh 27 (1870) 733-734

Female, length, including tegmina, about 8 millimeters.

Ochraceous. Vertex rounded, as long as half the distance between the eyes, foveate between eyes and ocelli, with two black

spots on apex of vertex equidistant from each other to eyes and above ocelli; two parallel brown fasciæ running longitudinally from apex down to clavus; frons broad and tumid, ochraceous, faintly striated with short perpendicular lines, one oblique brown marking on each lateral side; ocelli and eyes fuscous; face and clypeus ochraceous; pronotum transverse, basal and lateral sides rounded and margins truncate, four broad brown bands running longitudinally; scutellum triangular, acutely pointed at base, two central pronotal bands split on pronotum, dividing into four parallel longitudinal bands; clavus ochraceous with brown markings projected from head and notal regions, margined from claval suture by a red fascia which is one-third as wide as clavus; tip of tegmina transparent fuscous, rest of tegmina red with fuscous margin; wings fuscous, almost black; body and notal and abdominal dorsal region concolorous with wings; ventral side and legs yellowish ochraceous; last ventral segment with triangular-lobed sides and rounded central margin.

LUZON, Laguna Province, Los Baños (*S. S. Gonzales*), Mount Banahao. MINDANAO, Surigao (Osborn collection).

CICADELLA QUINQUENOTATA Stål.

Cicadella quinquenotata STÅL, Öfv. Vet.-Akad. Förh. 27 (1870) 734.
Kolla tripunctifrons BANKS, Philip. Journ. Sci. § D 5 (1910) 52, Palawan.

Length, including tegmina, about 9.25 millimeters.

Uniformly yellowish green. Vertex somewhat anteriorly produced, as long as wide between eyes, with discal black spots, two at apex, and two on margin in front of eyes; ocelli ochraceous-amber; eyes fuscous, with a distinct black spot on the lateral edge: face about one and one-half times as long as broad; frons swollen and somewhat flat on the middle, somewhat striate laterally; clypeus swollen and clearly separated by a suture; cheeks and lora pale pink; pronotum hexagonal, almost as long as broad with a curved transverse groove at anterior fourth, just back of the area of pronotal surface distinctly transversely wrinkled; scutellum small, somewhat wider than long; tegmina pale green to hyaline with brown venation.

One of the specimens has a faint spot on each lateral apex of vertex.

LUZON, Bataan Province, Mount Limay; Laguna Province, Mount Maquiling, Los Baños. MINDANAO, Zamboanga (Osborn collection).

CICADELLA ALTICOLA n. sp.

Length, about 8 millimeters.

Greenish ferruginous. Vertex roundly produced, as long as one-half the width between eyes, greenish brown with a round black marking on apical center; one on each vertical edge, and two on the side below; ocelli equidistant from each other and eyes; margin between eyes and apical center occupied by deeply striated portions which are continuous on each side to margin of frons; frons tumid and flat, on the center marked with fuscous striæ; center greenish brown; cheeks and clypeus greenish ochraceous; pronotum transverse, base slightly rounded, about one-half as long as broad, anterior half with irregular black markings; scutellum triangular with acutely pointed marginal angle, slightly broader than long, third marginal portion with horizontal fovea, and a longitudinal median sulcus dividing it into two parts, each portion with an apical fuscous dot and a lateral broad fuscous stripe; tegmina long with five apical and three anteapical cells, with distinct brown venation, apex distinctly margined. Body underneath greenish ochraceous; legs light brown.

LUZON, Benguet Subprovince, Mount Santo Tomas, Haight's Place, and Mount Polis: Nueva Vizcaya Province, Imugan (type, Osborn collection).

CICADELLA SUTURELLA (Stål).

Tettigonia suturella STÅL, Öfv. Vet.-Akad. Förh. 5 (1855) 192.

Length to tip of tegmina, 5.5 millimeters.

Vertex short, a little longer than one-half length of pronotum, with bluntly rounded apex, amber yellow, two black spots, one in each angle equidistant between the eye and the anterior portion, one on disc and two black spots surrounding the amber-colored ocelli; frons amber yellow with an elongated black spot on upper portion, disc distinctly foveate and marked on the sides by yellow striæ, lora and gena ochraceous; pronotum light yellow with two oblique lines from basal inner third to posterior base, forming an obtuse angle; scutellum amber orange, a transverse line on the middle, with two broken parallel black lines laterally, the continuation of pronotal lines on edges of tegmina forming the commissural lines; tegmina hyaline, with milky white venation, the borders of which are black and fuscous. Body underneath and legs pale yellow; last ventral segment truncate in male, slightly convex in female.

LUZON, Laguna Province, Pacte, Los Baños, and Pansol. NEGROS, Occidental Negros Province, Dumaguete. MINDANAO, Zamboanga.

Known host *Acalypha* sp., evidently widely distributed in the Philippines.

CICADELLA NIGRIFASCIATA sp. nov.

Male, length, including tegmina, 5.5 millimeters.

This species has morphological characteristics similar to those of *C. saturella* Stål, of about the same size and general appearance. The marking of this species is more accentuated. There are more spots and markings on the vertex. The notal markings are consolidated into a semicircle, in contradistinction to those of *C. saturella*, which are oblique, meeting at an angle. In males frons and clypeus entirely black, in some there is a black fascia on the middle of the frons and on the lateral margins of the frons and cheeks; fasciæ of frons connected by transverse striæ; scutellum with a longitudinal black marking near each lateral angle and confluent with the commissural black lines terminating at the tip of tegmina. Entire lateral margins of tegmina bordered by a black marking. Thoracic and abdominal sclerites marked partially with black at the middle, with the exception of the genital plates, which are ochraceous. The vertex is rounded, about one-third as long as the distance between the eyes; pronotum transverse, slightly wider than long, basal margin rounded, the lateral sides oblique, and posterior almost truncate; scutellum triangular, posterior half separated by an impressed line; body beneath the wings black; legs straminеous.

This species is abundant on cotton in the Philippines.

LUZON, Mountain Province, Mount Santo Tomas (type), Baibalan and Baguio (paratype, Osburn collection).

Genus MILEEWA Distant

Mileewa DISTANT, Fauna Brit. Ind. Rhynch. 4 (1908) 238; BAKER, Philip. Journ. Sci. § D 9 (1914) 415.

Type, *M. margheritæ* Distant.

According to Distant [33] this genus is known only from Assam. Baker [34] described a new species and a new variety of this species from Mount Maquiling, Luzon, and named the species *M. inconica*.

[33] Fauna Brit. Ind. Rhynch. 4 (1908) 238.
[34] Philip. Journ. Sci. § D 9 (1914) 415–416.

MILESEWA LUZONICA Baker.

Milesewa luzonica Baker, Philip. Journ. Sci. § D 9 (1914) 415–416.

Vertex, pronotum and scutellum ferruginous, the front margin of vertex and all below very pale yellowish, the tegmina washed with a shining ferruginous. A large rectangular spot in middle of vertex, 2 round spots near basal margin of pronotum, a varying and indistinct median area on posterior half of pronotum, lateral angles of scutellum broadly, a narrow longitudinal band on clavus within commissural margin and not reaching tip of clavus, a longitudinal band on corium bordering claval suture and passing into inner apical cell, and a band from base of tegmina passing to apex of first antecpical cell, black; area of apical cells smoky translucent. Length ♂ 4.5, ♀ 4.75 mm.

Length of face two and one-fourth times width between eyes, basal clypeal suture distinct, the whole surface faintly shagreened; front and clypeus strongly convex, the former slightly flattened on disc above. Length of vertex about three-fourths of width between eyes, surface smoothly convex. Ocelli nearly on line of anterior margin of eyes, somewhat nearer to eyes than to each other. Pronotum smooth, the pleural carina very fine but complete. Scutellum wider than long, a fine impressed transverse line at middle. Tegmina opaque proximad of apical cells, but not all coriaceous and not at all punctate. If viewed squarely the hind margin of last ventral segment appears to be slightly incurved and with a median projection, the hind angles oblique; if viewed at a slight angle the hind margin appears to be deeply emarginate.—Baker, loc. cit.

My specimens were all collected near Los Baños, at the foot of Mount Maquiling. The color of the vertex, pronotum, and scutellum is orange and not ferruginous; the tegmina is of the same color, except the clavus which is greenish yellow; the ocelli are equidistant from each other and from the eyes; and the scutellum is equilateral. The rest of the characters conform to Baker's description of the insect. In the Osborn collection there is a specimen collected at Subaan, Mindoro, and another collected at Haight's Place, northern Luzon. The latter specimen is pale, slightly larger than the rest, and the pronotal markings are quite indiscernible.

Genus MAKILINGIA Baker

Makilingia Baker, Philip. Journ. Sci. § D 9 (1914) 409–410; 24 (1924) 57–58.

Type, *M. nipra* Baker.

This genus was erected by Baker [1] for a group of small Tettigoniellinæ colored principally black and red, rarely whitish, collected on Mount Maquiling and Mount Banahao, which later on

[1] Tom. cit. 410–411.